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EMERGING ISSUES FOR BIODIVERSITY CONSERVATION IN A CHANGING CLIMATE

Secretariat of the
Convention on
Biological Diversity

CBD Technical Series No. 29

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Abstracts of Poster Presentations at the 12th Meeting of the Subsidiary Body on Scientific, Technical and Technological Advice of the Convention on Biological Diversity
2–6 July 2007 in Paris, France

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FOREWORD

Land-use and climate change are predicted to lead to substantial contractions in the geographical spread of species and eventually to species extinctions. The 2007 Fourth Assessment Report of the Intergovernmental Panel on Climate Change predicts that between 20 to 30% of all known species may disappear before the end of the century. A recent study on the projected impacts on global bird diversity published on the World Wide Web by the Public Library of Science predicts that by 2100, even under environmentally benign scenarios, over 10% of the world's land bird species will suffer reductions of the territories in which they occur by at least half. The number of bird species threatened by extinction will thereby increase significantly. In addition, the 2006 Stern Review on the Economics of Climate, commissioned by the Government of the United Kingdom, has highlighted the costs of delaying action to combat climate change.

A coherent implementation of commitments and obligations to the biodiversity and climate change agendas will be critical to limit the damage. It is for this reason that the Secretary-General of the United Nations, Mr. Ban Ki-moon, in his message contained in the present publication and delivered on the occasion of the International Day for Biological Diversity, celebrated this year under the theme biodiversity and climate change, stressed the need for the "global response to biodiversity and climate-change challenges to move much more rapidly and with much more determination at all levels: global, national and local". He concluded his message by stating that for the sake of current and future generations we must achieve the goals of the landmark instruments that are the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change.

At its twelfth meeting, to be held in July 2007, the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) of the Convention on Biological Diversity will consider scientific and technical issues of relevance to the implementation of the Convention, including items related to biodiversity and climate change. Accordingly, the theme of the poster session at the meeting is "Emerging issues for biodiversity conservation in a changing climate".

Parties, other Governments and relevant United Nations, intergovernmental, non-governmental, regional and international organizations, indigenous and local communities, and the private sector were invited to contribute poster papers and extended abstracts that describe issues for biodiversity conservation that are emerging as a result of climate change. Contributors were encouraged to link their topics to the 2010 biodiversity targets, the Millennium Development Goals, poverty alleviation and/or any other relevant agreed goals in the framework of the Plan of Implementation adopted at the 2002 Johannesburg World Summit on Sustainable Development, the United Nations Convention to Combat Desertification, the United Nations Framework Convention on Climate Change, and other biodiversity-related conventions.

It is my hope that the contributions contained in this publication will stimulate awareness about the interlinkages between biodiversity and climate change. These interlinkages run both ways. To name a few, biodiversity is affected by climate change through the alteration of habitats as a result of global warming, sea-level rise, loss of snow and ice cover, and an increased frequency and intensity of extreme weather events. At the same time, actions to conserve and sustainably use biodiversity increase the resilience of ecosystems in the face of climate change and help offset its effects.

Biodiversity should therefore be central to efforts to mitigate and adapt to climate change. The Convention on Biological Diversity is in a phase of enhanced implementation, and the Secretariat is assisting with regional and sub-regional efforts by Parties to achieve the objectives of the Convention to conserve, sustainably use, and equitably share the benefits arising from biological diversity. By striving to significantly reduce the rate of loss of biodiversity by the year 2010, we will at the same time be bolstering our own resistance to the negative effects of climate change.

There is much that is being done and there is more that could be done to slow the rate of biodiversity loss. These poster presentations, thoughtfully presented by many different actors in the field of the environment, offer us examples of interactions between climate change and biodiversity around the world, from their own perspective. These experiences should be taken in their context and used in our own work to reduce the loss of biodiversity and mitigate and adapt to the effects of climate change.

I wish to gratefully thank all those who have contributed abstracts in this 29th publication in the CBD Technical Series.

Ahmed Djoghlaf
Executive Secretary

THE SECRETARY-GENERAL MESSAGE ON THE INTERNATIONAL DAY FOR BIOLOGICAL DIVERSITY 22 MAY 2007

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

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

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

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

Through the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change, the international community is committed to conserving biodiversity and combating climate change. The global response to these challenges needs to move much more rapidly, and with more determination at all levels — global, national and local. For the sake of current and future generations, we must achieve the goals of these landmark instruments.

Ban Ki-Moon
United Nations Secretary-General

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IMPACTS OF CLIMATE CHANGE ON BIODIVERSITY

DOES CLIMATE CHANGE PROMOTE INSECT OUTBREAK SITUATIONS AND ALTERED FOREST ECOSYSTEM FUNCTIONS?

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Keywords: herbivore insect outbreaks, climate change, altered nutrient fluxes, forest ecosystems, structural and species diversity

STATUS QUO AND TRENDS OF THE ROLE OF INSECT OUTBREAKS IN FOREST ECOSYSTEMS

Outbreaks of canopy native phytophagous insects are a phenomenon, which is often induced by a low structural- and species diversity, advantageous climatic conditions and a low resistance of forests which cause heavy damages by frass activities (Kulmann, 1971; Day & Leather, 1997; Langstrom et al, 2001; Cedervind, 2003). In view of a globally rising temperatures (Cramer, 1987; IPCC, 2007), outbreak pattern are suggested to change spatially (larger areas are attacked) and temporally (outbreak ranges are getting closer) (Raymond & Cannon, 1998).

From the long-term perspective of a forest ecosystem, insect herbivore can act as a regulator of forest primary production, leading to increasiell above ground biodiversity after defoliation (Fonte & Schowalter, 2000; Hartley & Jones, 2004). Mattson & Addy (1975) suggested, that herbivore insect feeding activities can increase light penetration through the foliage canopy, reduce competition among plants, increase input rate of fall of nutrient-rich litter, stimulate the redistribution of nutrient within plants, as well as the decomposition activity. The view of that fact that herbivore insects likely contribute to increase nutrient availability and subsequent productivity, it became inappropriately linked with the “herbivores as mutualists” hypothesis, in which herbivores are seen to increase the fitness of plants upon which they feed (Dyer & Bokhari, 1976; Owen & Wilgert, 1981; Hunter, 2001)

In our project we investigate the importance and role of leaf feeding insect mass outbreaks on the production of canopy derived C and N fluxes and their above and belowground effects in forest ecosystems.

INCREASING INSECT OUTBREAKS AS INDICATOR FOR CLIMATE CHANGE

In irregular intervals, forest stands are infested by herbivores insect mass outbreaks, where high rates of foliar biomass (canopy) are transformed by the insects into organic matter (OM). We assume that canopy native insects take an important part in the production of organic matter, which enters the soil as herbivore-derived inputs (faeces, green leaf fragments and modified throughfall) and as DOM (dissolved organic matter) and POM (particulate organic matter). We presume, that these inputs influence the soil chemistry and therewith soil processes. Additionally we assume, that the enhanced production of organic matter under outbreak situations influences the C- and N- budget of soils and in general the turnover of nutrients within ecosystems, from which an increased nutrient availability and above and belowground activity (diversity) might result and which subsequently might stabilise forest ecosystems. For understanding the importance of increasing numbers of outbreak situations for forest ecosystems, likely reflecting the trend for global warming, we analysed the dynamics of DOM and POM by throughfall, the productivity of insect faeces and frass by nylon nets and their effects on the soil microbial activity by adenylate and microbial biomass (CFE) analysis.Our study could show, that organic C impacts by throughfall under outbreak situation during six month exceeded the annual C impacts in temperate forest ecosystems (180 kg C/ha/6 months > 160 kg C/ha/year). Furthermore impacts by frass via tree net arised up to 520 kg C/ha/6 months. The proportion of easy biodegradable carbohydrates may amount to 50% and are mainly derived from microbial and phytophageous activity (Guggenberger & Zech, 1994). Furthermore, the quality and origin of POM and potential effects of climate change on biospheric feedback processes (e.g. herbivore population dynamics, leaf/needle quality) is just poorly understood.

The study was carried out in a German pine forest (Lower Saxony) in weekly sampling intervals from April to October 2005. This project is cooperation between the University Gottingen and the research centre of forest environment Goettingen (NW-FVA) and is supported by the German Research Community (DFG) and accompanied by the international organisation "F**riend's of the Earth Germany**".

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FIG 1: DOC (Dissolved Organic Carbon), TOC (Total Organic Carbon), DNB (Dissolved Nitrogen Bounded), TNB (Total Nitrogen Bounded)

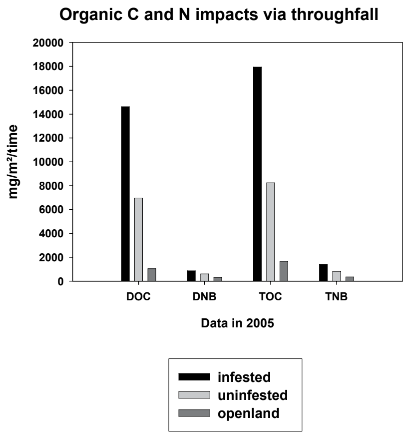
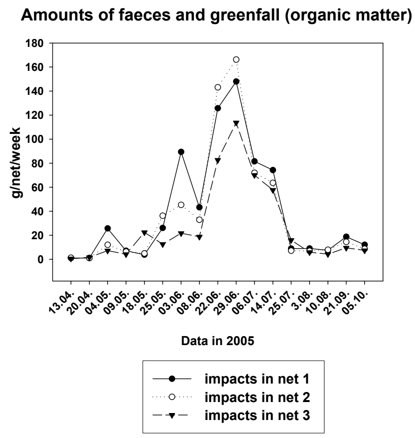


FIG 2: Impacts of herbivore derived faeces and greenfall from leaf feeding activity via tree net sampling (net 1, 2, 3)



THE AUSTRALIAN NATIONAL BIODIVERSITY AND CLIMATE CHANGE ACTION PLAN

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Key words: biodiversity and climate change, action planning, Australia, biodiversity conservation

INTRODUCTION

Australia's biodiversity is rich and unique, and has evolved over millions of years in response to the continent's long isolation, ancient and infertile landforms and unpredictable climate. A growing body of research indicates that our terrestrial and marine species and ecosystems are vulnerable to current trends in climate change, particularly in combination with the demands of a growing population. Australia's National Biodiversity and Climate Change Action Plan (NRMMC 2004) has been developed to minimise the impacts of climate change on biodiversity through adaptive planning.

AUSTRALIA'S BIODIVERSITY IN A CHANGING CLIMATE

Australia is the driest inhabited continent with an historically variable climate and high susceptibility to drought. With a land area of some 7.7 million square kilometres and a marine exclusive economic zone of some 10.0 million square kilometres, Australia supports a range of species and ecosystems spanning tropical to cold temperate. Australia's biota is extraordinarily diverse with high levels of endemism: some 80% of terrestrial and aquatic flora and fauna, and more than 85% of marine fish, molluscs and echinoderms occur nowhere else in the world. The 2006 State of the Environment report (Beeton *et al.* 2006) summarises current environment trends and climate change projections.

Australia's biodiversity is at risk from climate change, particularly where it is accompanied by decreased annual rainfall and increased temperatures (projected over much of the continent), sea level rise and changes in sea water chemistry, and increased frequency and severity of disturbances such as fire, drought, cyclones and floods (Hughes 2003, Hobday *et al.* 2006). Change is already observable (Beaumont *et al.* 2006).

Species and communities at particular and possibly critical risk include those with limited climatic ranges (e.g. the woodlands and heathlands of southern Western Australia), limited dispersal ability (e.g. endemic species of the Australian Alps and tropical rainforests (Williams *et al.* 2003)), and those with specialised habitat requirements (e.g. the Great Barrier Reef).

THE ACTION PLAN

Genesis and Development

The real and potential impacts of climate change on biodiversity were already being detected in the early 1990s, when Australia prepared *The National Strategy for the Conservation of Australia's Biological Diversity* (Commonwealth of Australia 1996). Climate change impacts were further examined in 1998 through the *National Greenhouse Strategy: Strategic Framework for Advancing Australia's Greenhouse Response* (Commonwealth of Australia 1998). In 2001, the *National Objectives and Targets for Biodiversity Conservation* (ANZECC 2001) specified a target to 'develop an action plan to identify the potential impacts of climate change on Australia's biodiversity and measures to address these impacts'. By 2004, Australian governments had cooperatively developed the *National Biodiversity and Climate Change Action Plan 2004–2007* (Action Plan).

Overview

The Action Plan focuses on research, integration, capacity building and education. It operates through seven objectives, and a set of subsidiary strategies. Actions are listed under each strategy, together with the appropriate jurisdictional responsibility and proposed date for undertaking the action. The attached table lists the objectives and strategies.

The objectives can be divided into three main steps: gathering knowledge and increasing awareness; minimising impacts on biodiversity; and incorporating knowledge and adaptation or mitigation strategies into natural resource management.

Objectives 1 and 2 recognise gaps in the understanding and awareness of the impacts of climate change on biodiversity. They target specific research, propose capacity building for information exchange between managers, and encourage informed public discussion.

Objectives 3–5 focus respectively on strategies for minimising impacts on freshwater, marine and terrestrial ecosystems. Strategies for all three ecosystem types include improving capacity through changes in knowledge and planning, maximising the resilience of existing ecosystems, and strengthening the capacity of the reserve system to act as refuges. Objective 6 considers invasive organisms, including the capacity to predict the distribution of new and existing alien organisms, and the invasive capacity of native organisms.

Objective 7 encourages land-use planners and natural resource managers to incorporate consideration of the impact of climate change on biodiversity as a component of their work relating to all biodiversity conservation issues.

Governance Arrangements

Implementation of the Action Plan is coordinated by a national task group, comprising representatives of government and the Commonwealth Scientific Industrial Research Organisation, which reports on progress to Ministers responsible for natural resource management.

Much of the work under the Action Plan is being implemented through existing programmes, ensuring that climate change is considered as one of a number of risks to biodiversity. Projects are underway on the impact of climate change on marine biodiversity and terrestrial protected areas, including Australia's World Heritage Properties and the National Reserve System.

In November 2006, Ministers agreed to fund a set of priority actions under the Action Plan. These include:

- A strategic national assessment of the vulnerability of Australia's biodiversity to climate change;
- A national case study to integrate climate change into management of disturbance regimes (using fire as an example) in areas managed for biodiversity conservation;
- Identifying of steps and processes for integration of climate change into environmental management systems and similar systems;
- Finalising an approach to a national coastal vulnerability assessment;
- Climate change guidance for water planning under the National Water Initiative;
- Assessing implications of climate change for high conservation value ecological water requirements; and
- Progressively developing and disseminating information aimed at raising awareness of the vulnerability of regions to climate change, in forms and at scales relevant to natural resource managers

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TABLE: The objectives and strategies of the Australian National Biodiversity and Climate Change Action Plan

Objective 1:	**To improve our understanding of the impacts of climate change on biodiversity**
Strategy 1.1	Addressing important gaps in our knowledge about climate change impacts on biodiversity, and on the cumulative effects of other threatening processes whose impacts on biodiversity will be exacerbated by climate change, at scales relevant to adaptive planning
Strategy 1.2	Maintaining and improving capacity to predict climate change impacts on biodiversity
Strategy 1.3	Increasing capacity to monitor impacts on biodiversity and evaluating the effectiveness of adaptation strategies and actions
Strategy 1.4	Addressing information needs of NRM managers and decision makers involved in developing and implementing strategies to minimise the loss of biodiversity due to climate change
Strategy 1.5	Improving and increasing capacity to assess environmental, economic and social costs and benefits of taking action
Objective 2:	**To increase awareness of climate change impacts and our capacity to respond**
Strategy 2.1	Improving information systems and flows between key groups
Strategy 2.2	Developing a targeted communication strategy to promote awareness in the broader community
Strategy 2.3	Increasing capacity of Natural Resource Management and environmental planners and decision makers
Objective 3:	**To minimise the impacts of climate change on inland aquatic and semi-aquatic ecosystems**
Strategy 3.1	Building capacity to predict the impact of climate change on aquatic and semi-aquatic species and ecosystems
Strategy 3.2	Integrating consideration of the impacts of climate change on biodiversity into water allocation and management strategies that deal with hydrological systems

Strategy 3.3	Maximising the resilience of inland aquatic and semi-aquatic ecosystems to manage the impacts of changes in catchment hydrology resulting from climate change
Strategy 3.4	Reviewing reserve acquisitions to strengthen the capacity of the reserve system to act as refuges for vulnerable inland aquatic and semi-aquatic species and communities and to encompass bioclimatic gradients
Objective 4:	**To minimise the impacts of climate change on marine, estuarine and coastal ecosystems**
Strategy 4.1	Building capacity to predict the impact of climate change (including sea level change and resulting storm surges) on marine, coastal and estuarine species and ecosystems in ecological and socioeconomic terms
Strategy 4.2	Identifying and integrating into marine, coastal and estuarine management strategies (particularly for marine protected areas), activities that minimise the impacts of climate change (and sea level change) on vulnerable marine, coastal and estuarine species and ecosystems
Strategy 4.3	Maximising the resilience of marine, coastal and estuarine species and ecosystems to climate change impacts
Strategy 4.4	Protecting near-shore species and ecosystems from changes to catchment hydrology resulting from climate change
Strategy 4.5	Considering the impacts of climate change on marine, estuarine and coastal biodiversity when selecting new marine protected areas and for management planning and monitoring regimes
Objective 5:	**To minimise the impacts of climate change on native terrestrial species, communities and ecosystems**
Strategy 5.1	Identifying and incorporating into vegetation management strategies across all tenures, ongoing activities to improve the opportunity for species at risk from climate change to adapt
Strategy 5.2	Reviewing reserve acquisitions to strengthen the capacity of the reserve system to act as refuges for vulnerable terrestrial species and integrate reserve planning and management with broader landscape protected area networks to allow the movement of species across bioclimatic gradients
Strategy 5.3	Conserving threatened species that have the potential to become extinct as a result of climate change impacts
Objective 6:	**To minimise the impact of invasive organisms on biodiversity in future climates**
Strategy 6.1	Building capacity to predict the effects of climate change on the distribution of new and established alien invasive organisms
Strategy 6.2	Considering the implications of native species becoming invasive, and incorporating this information as appropriate into invasive species and threatened species programs
Strategy 6.3	Preventing the establishment of new alien invasive organisms in Australia, which could be attributed to climate change
Strategy 6.4	Reviewing priority alien invasive organisms for management action and re-evaluation alien invasive organism management strategies, taking into account the potential effects of climate change on their distribution
Objective 7:	**To factor the impacts of climate change on biodiversity into natural resource management (NRM) and land-use planning**
Strategy 7.1	Incorporating consideration of climate change impacts on biodiversity into NRM/biodiversity policies, strategies and programs, consistent with ecologically sustainable development policies
Strategy 7.2	Incorporating consideration of climate change impacts on biodiversity into land-use planning and land-use change programs
Strategy 7.3	Incorporating consideration of climate change impacts when listing threatened species and ecological communities and, in planning for the recovery of these species and ecological communities, ensure prioritisation

ESTABLISHING AN INVASION-ASSESSMENT AND EARLY WARNING SYSTEM FOR INVASIVE ALIEN SPECIES (IAS) IN GERMANY AND AUSTRIA

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keywords: Central Europe, climate change, invasion-assessment, invasive, modelling, nature conservation,

INTRODUCTION

Invasive alien species (IAS) are species introduced deliberately or unintentionally outside their natural habitats where they threaten biodiversity. On a global scale, IAS represent the second-largest threat to biodiversity after habitat loss. Climate change will prob ably further aggravate the situation, both by affecting the distribution of native species, and by enabling some alien species to become more common. In a second step, these species may become invasive (Millennium Ecosystem Assessment 2005). With view to the 2010 target, tackling the challenge of IAS is essential (CBD Guiding Principles 2002, EC 2006).

Controlling or eradicating invasive species once they are established is often extremely difficult and costly, while prevention and early intervention have more chances to be successful and cost-effective. That is why, in addition to inviting the member states to develop national strategies to cope with IAS, the European Commission proposes the establishment of a Europe-wide early warning system by 2008 (EC 2006).

The German Federal Agency for Nature Conservation seized this suggestion and commissioned a project to the Austrian Environment Agency. The project applies the precautionary principle by modelling the distribution of IAS under different climate change scenarios and by building a framework for an early-warning system for both countries. The results of this study can feed in the development of a European early-warning system. The study started in December 2006 and will be finished by March 2009.

METHODS AND PROJECT AIMS

Geographic and taxonomic scope

The project includes two countries: Germany and Austria. Both countries have undergone "typical" European land use histories, are similar in regard to their biogeographic setting and to invasion-relevant socio-economic drivers (e.g. GDP per capita, trade intensity). On the other hand, they differ in regard to some other factors (e.g. size, population density, access to coasts). Climate change-induced shifts in species' distribution are likely to be transnational. With regard to the two countries, species are expected to move from Austria to Germany.

The project focuses on two taxonomic groups: fish and vascular plants. Both groups include some of the worst IAS in Europe (e.g. Kowarik 2003, Essl & Rabitsch 2004), and good quality data on their ecology and distribution are available. The results of this transnational study may serve as a model for predictions of species' distribution shifts in a changing climate.

Creating an invasion-assessment scheme for IAS

The first work package is the creation of an invasion-assessment scheme. It will focus on effects of IAS on biodiversity, building on and integrating existing national schemes (e.g. Köhler & Weber 2005). The assessment scheme will be criteria-based, transferable, and easy to handle. IAS will be classified into different categories, each of which requiring different kinds of action. The results of this part are expected for Autumn 2007.

Assessing climate change impacts on IAS

Climate change impacts on IAS will be explored by modelling a subset of fish and vascular plant species. Species will be selected to represent different stages of invasion, pathways, and life histories. Modelling of their future distribution will be based on the species' recent distribution in Austria and Germany (fine-scaled grid-based distribution maps, cell size appr. 30 km^2) and on environmental and climate variables (e.g. geology, altitude, land use, temperature), which are expected to shape current distribution of IAS. Species habitat models will be coupled with regional climate scenarios. The results, which will be available by Autumn 2008, will allow assessing the magnitude of distribution changes of IAS in two countries of Central Europe under different climate change scenarios.

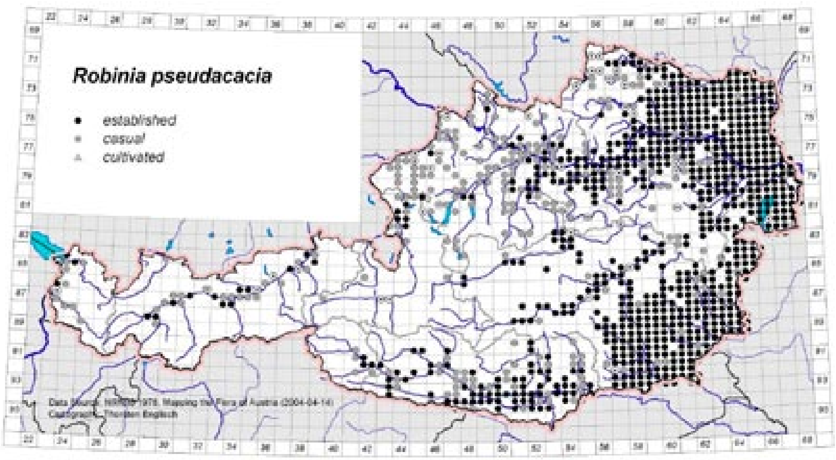
Establishing an expert-based early warning system on IAS

The creation of an expert-based early warning system on IAS will allow the early detection of newly-introduced IAS and the tracking of expansion of already present species, at a stage where rapid measures may still be effective. The expert network shall include taxonomic experts, nature conservationists, and staff of national and regional nature conservation agencies.

Conclusion & Outlook

This project will deliver methodologies, which will strengthen the knowledge and the instruments for handling IAS. Furthermore, due to its transnational focus, this project may serve as a model for the establishment of an early warning system on IAS in the EU.

FIGURE 1. Current distribution of black locust (*Robinia pseudacacia*) in Austria. This tree species heavily invades dry grasslands in eastern Austria and is expected to profit from rising temperatures.



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AN '(EVER)GREENER WORLD' WITH CLIMATE CHANGE

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Keywords: Range shifts, global warming, evergreen broad-leaved species, ecosystem services & functioning

INTRODUCTION

The vegetation of central Europe is relatively poor in native evergreen broad-leaved species compared to temperate regions of other continents. However, these few species have attracted the interest of generations of scientists, and thus, the factors limiting their northern distribution have been well studied in the past (Iversen 1944). Climate, especially temperature and the length of the growing season, has been pointed out as an important factor determining establishment and survival of evergreen broad-leaved species at their northern range margins, in Europe and worldwide (Box 1981, Woodward 1987, Woodward *et al.* 2004).

The fact that even the most cold-hardy evergreen broad-leaved species are sensitive to low winter temperatures makes them suitable as climate indicators. This fact has been applied to reconstruct past climatic fluctuations from geological records (Iversen 1944). Bioclimatic indicators serving the reconstruction of past climatic conditions may also be used as indicators of recent and near-future climate change. Recent climate change has left visible 'fingerprints' within different ecosystems all over the world (Walther *et al.* 2001, Parmesan & Yohe 2003, Root *et al.* 2003), and the warming trend is expected to continue or even increase (IPCC 2007). We here analyse how the cold-hardiest evergreen broad-leaved species, a group including both natives and exotic plants, shift their northern range margins in concert with recent global warming.

A COHERENT RANGE SHIFT OF EVERGREEN BROAD-LEAVED PLANTS WITH CLIMATE WARMING

Updated field data and outputs from bioclimatic models (for the latter see Sykes *et al.* 1996, Ohlemüller *et al.* 2006) reveal that the milder winter conditions of the last few decades are consistent with the northward expansion of potential ranges and an increase in the number of evergreen broad-leaved species (e.g. Walther 2000, Walther *et al.* 2005, 2007). The assemblage of currently spreading evergreen broad-leaved species in Europe might be divided into three subgroups based on their origin: (I) species native to Europe, expanding their previous ranges by themselves but also facilitated by human introductions, e.g. *Ilex aquifolium* and *Laurus nobilis*; (II) species widespread throughout the Tertiary not able to recolonise central Europe in the Holocene, but reintroduced as ornamentals from nearby refugial areas, e.g. *Prunus laurocerasus*; and (III) species introduced from more distant parts of the world, e.g. *Trachycarpus fortunei*, *Cinnamomum glanduliferum*. Updated distribution maps were superposed on potential distribution areas of the species based on species' specific bioclimatic parameters (Berger *et al.* 2007). The potential species' distributions overlap in substantial parts of central Europe, with gradually decreasing number of species' ranges towards the northeast (Figure 1). Survival in formerly unsuitable areas has become possible under climatic warming (Walther *et al.* 2005, 2007). However, at the local scale, not only macroclimatic limits but also other ecologically relevant parameters, e.g. edaphic factors, must be taken into account, as they also influence the diversity and structure of communities with an increasing share of evergreen broad-leaved species (Berger & Walther 2006). This is of special importance at species range margins, as the habitat requirements of species become more specific towards range boundaries (Thomas *et al.* 2001).

THE REORGANISATION OF COMMUNITIES WITH CLIMATE WARMING

The fact that responses to climate change are species' specific, suggests that climate change in the longer term will lead to a reorganisation of existing communities rather than to synchronous shifts of whole vegetation units. Furthermore, as there are only few native evergreen broad-leaved species in northern and central-European plant communities, the aforementioned range shifts led to distinct changes in the diversity and physiognomy of existing forest communities (Gianoni *et al.* 1988), and foreshadows assemblages of new species combinations (cf. Chapin *et al.* 1993, Scoles & Van Breemen 1997). Recent climate change has favoured the evergreen broad-leaved plant functional type within deciduous forests (Figure 2). With continued warming this process is likely to proceed and to induce changes in the composition and structure of temperate deciduous forests in various parts of central Europe (Figure 1). Other human activities also cause changes to the native vegetation, for example the introduction of new species. The combination of these anthropogenic influences facilitates the formation of new vegetation types as shown here with an example for Central Europe.

Acknowledgements

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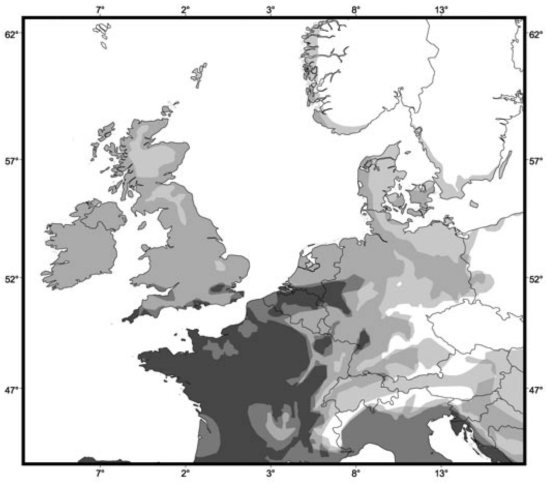

FIGURE 1: Superposed potential distribution (based on climatic data of the reference period 1991-2000) of four selected evergreen broad-leaved species: *Ilex aquifolium*, *Prunus laurocerasus*, *Laurus nobilis* and *Trachycarpus fortunei*. Shading represents the number of evergreen broad-leaved species (overlap of all four species' potential ranges indicated by the darkest shading, decreasing gradually with decreasing number of species' potential ranges overlapping) (from Berger *et al*. 2007).

FIGURE 2: Reorganisation of a forest community in southern Switzerland with deciduous broad-leaved species in the tree layer and newly invading evergreen broad-leaved species dominating the shrub layer. (Photo: G.-R. Walther)

IMPACT OF THE ANTHROPIC ACTION AND ARIDITY ON THE BIODIVERSITY IN THE STEPPES OF ALGERIA

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Keywords: Floristic diversity, Aridity, anthropic Action, Desertification
Mots clés : Diversité floristique, Aridité, Action anthropique, Désertification

RESUME

L'état actuel des parcours steppiques est le résultat des contraintes d'un milieu précaire (aridité climatique et édaphique) et d'une exploitation anthropique ancienne et de plus en plus intense.

Pour évaluer la diversité floristique des steppes à alfa, une matrice de 183 relevés et 499 espèces récoltées dans toutes les formations à alfa de l'Algérie, a été soumise à des analyses factorielles des correspondances combinées à la classification hiérarchique ascendante.

Les facteurs écologiques déterminant dans la répartition de la végétation mis en évidence par le premier traitement numérique (analyse globale) seraient la pluviosité, la thermophilie, la dégradation d'origine anthropique, la moyenne des températures minimales du mois le plus froid (m) et l'état de la surface du sol.

Le deuxième traitement qui a consisté en des analyses partielles a permis la discrimination de dix (10) groupements de relevés caractérisés d'une part sur le plan biologique et phytochorique à travers la détermination de leurs spectres bruts et réels et d'autre part sur le plan pastoral par l'indice pastoral (Is). Par ailleurs la diversité floristique a été exprimée à travers le calcul des indices de diversités (Shannon et équitabilité) et la construction de diagrammes Rang Fréquences (DRF) pour chaque groupement.

Les résultats de ces analyses montrent sur le plan biologique une thérophytisation et une chamaephytisation traduisant ainsi une dynamique régressive de la végétation. Au point de vue phytochorique cette dernière est caractérisée par une réduction relative des éléments méditerranéens et endémiques l'augmentation des saharo arabiques dû essentiellement à l'aridité du climat.

La flore de notre dition est riche de 496 espèces réparties sur 46 familles et 256 genres. Les familles les plus représentées sont les Astéracées (19.5%), les Poacées (10.4%), les Brassicacées (10.2%) et les Fabacées (10.2%). Globalement 30% de ces taxons sont classés rares parmi lesquels figurent des espèces à intérêt fourrager.

Sur le plan pastoral la flore de notre région d'étude est constituée de 60% d'espèces classées bonnes et très bonnes pastorales. La caractérisation pastorale des différents groupements par le calcul de leur valeur pastorale ne montre pas de corrélation entre cette dernière et les gradients pluviométrique et anthropique.

Les indices testés (Shannon et équitabilité) ainsi que les diagrammes Rang Fréquences ont montré que la diversité spécifique serait influencée par les conditions écologiques stationnelles (voile sableux et ensablement).

CLIMATE CHANGE: HAPPY FUTURE FOR PLANT PESTS?

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Keywords: impacts on plants, establishment, spread, overwintering, global warming, plant pathogens

INTRODUCTION

It is expected that climate change will have essential effects on plants and plant pests including pathogens, influencing their establishment, spread and reproduction rate. This may cause changes of ecosystems and influence for example the balance of existing complex interactions between plants and plant pests. As a consequence, biodiversity could be directly or indirectly affected.

Existing studies suggest that direct effects of temperature are likely to be larger and more important than any other factor, though other factors, like a rise in atmospheric CO_2 concentration, have to be considered as well. Direct effects of temperature rise on organisms may be greater in the polar regions than in temperate or tropical zones. This reflects the more severe environmental conditions, the tighter constraints and the prediction of much larger proportional temperature rises in these areas. The larger the geographical range of an organism, the lesser it will tend to be affected. The main effect of temperature in temperate regions is to influence winter survival. Towards the poles, higher temperatures extend the summer season, which increases the available thermal budget for growth and reproduction. Natural spread of pests is accelerated towards the North, as former climate barriers are no longer effective. Temperature may induce changes in life-cycle duration (rate of development), voltinism (number of generations in a year), population density, size, genetic composition, extent of host plant exploitation as well as local and geographical distribution linked to colonization and extinction (Bale *et al*. 2002). But, for many species, it is not small differences in temperature affecting them, it is the likelihood of sudden frosts after periods of warm weather. It is therefore not only the magnitude of change that is important, but also the unpredictability in the system.

EFFECTS ON HOST PLANTS AND PLANT PESTS

Development and growth of plants can significantly be influenced by climate change. Atmospheric CO_2 concentration has increased significantly since pre-industrial times and is predicted to reach double the pre-industrial concentration by the end of this century. This aspect is especially relevant for plants. Higher CO_2 rates change the structure of plants and can result in increased leaf area, leaf thickness and number of leaves. Pests can benefit from that by increased reproduction rate and subsequently more effective spread.

Climate change effects on host plants may indirectly favour the impact of pests on these plants. For example drought stress could make host plants more vulnerable to pests (e.g. bark beetles) or even shift host plant ranges. At latitudes towards the poles, where temperature is lower, the host plant grows much slower whereas in warmer areas, the plant may develop very quickly. As a result, adaptations both from the plants and the herbivores are necessary to perform well under these different conditions. With climate change, new adaptations will be necessary and distribution of plant species will be changed.

Under current climate conditions, a series of plant pests are not able to establish in temperate climates, as temperatures are too low or warm seasons too short for them to finish their life cycle. Another reason may be that they do not have a diapause enabling them to overwinter and to exist over wide geographical ranges. Also, effects on pests already established can be anticipated, when higher temperatures increase number of individuals and accelerate development, resulting in earlier infestation of host plants, higher infestation rates, and increased number of generations. On the other hand, climate change may have negative effects on pests from temperate climates. Though individuals may develop faster at higher temperature and survival may even be enhanced, they may consequently have lower adult weight and fecundity.

Effects of climate change on plant pests can be direct, by impacts on their physiology and behaviour, or indirect, when responding to climate-induced changes mediated through other factors, in particular the host plant. For example successful life-cycle completion in many host specific insect herbivores requires close synchrony with host phenology. With changing climate, synchrony between host plants and insect herbivores is likely to decrease, with negative consequences on entire ecosystems, as herbivores are central to ecosystem structure and function, and an increase or decrease in abundance, presence or absence can have significant effects on these.

With increasing temperatures also in higher altitudes, pests can spread more efficiently. E.g. bark beetles are normally restricted to lower levels of coniferous forests, but with an increase of temperature, coniferous populations are also threatened at high altitude areas.

EXAMPLES

The exotic oomycete *Phytophthora cinnamomi* is one of the most widely distributed and destructive forest pathogens. In Europe, it causes declines and stem cankers mainly on chestnuts, oaks and nursery plants. Disease development is strongly limited by cold winters. However, this is depending on where the pathogen overwinters: in aerial systems, its survival is more limited than in root systems. In oaks, the pathogen is present in the trunk – thus disease is hampered in colder climates. Global warming will result in higher winter survival of the pathogen, and subsequently in potential range expansion of canker symptoms of one to a few hundred kilometres in one century.

Tomicus destruens, a bark beetle (Scolytidae), infests pine stands and is the most dangerous pine pest in Italy. Affected pine species in dryer Mediterranean areas (Spain, South of France, Portugal, Italy) are *Pinus pinaster*, *P. pinea*, *P. halepensis*, *P. brutia*, and *P. canariensis*. Its distribution and spread is limited by temperature and humidity. *T. destruens* was first reported in Croatia on *P. halepensis* as a consequence of the extreme summer in 2003. It is expected to spread soon to Austria.

CONCLUSIONS

At first sight, a positive effect of climate change on plant pests could be expected, making them more dangerous and presenting by this a more severe threat to biodiversity. However, the overall impact of different factors has to be considered - the measurement of a single parameter does not give an overall picture, because the system is complex, and the synchrony between plants and plant pests plays an important role. Pests may perform principally better with higher temperatures, but then possibly the phenology of the host plant does not match anymore. Therefore the question whether climate change really means "happy future for plant pests" has to be evaluated case by case.

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PRELIMINARY CONCLUSIONS OF THE DISCUSSION ON CLIMATE CHANGE AND BIODIVERSITY IN GERMANY FROM THE POINT OF VIEW OF BUND BERLIN

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Keywords: global climate change, nature conservation, NGO, BUND, environment education, environment communication

INTRODUCTION

Global climatic change is becoming more and more obvious. Serious scientific votes denying the anthropogenic source of this development are isolated. Discussions of the topic are held on scientific, political and increasingly also on economic levels. Yet examination of the consequences of climatic change for nature conservation and environmental protection and their instruments is only just beginning. A differentiated reflection of climatic changes' impact on the work of nature conservation and environmental protection organisations has not yet been implemented.

Challenge for nature conservation and protection of species

Doyle and Ristow (2006) have presented the current challenges nature conservation has to meet against the background of climatic change from a scientific perspective. Already to be seen and to be further expected are changes on all levels of ecosystems. On a species level not only autecological but in the following also demecological reactions are to be expected. Among others, areal shifts will occur, resulting in changes of synecological parameters as e.g. food chains, decomposition processes etc. Thus ecosystems are increasingly subject to local discontinuities: extreme events, extinction of species or decline of intraspecific diversity and an increase of neophythes and neozoics can be expected. Overall the dynamics of ecosystems will increase, though depending on the time horizon considered.

All these processes have to be evaluated on a case-by-case basis in the view of nature conservation. In this context the question occurs: are current instruments of nature conservation appropriate to fulfil their functions in future?

What is characteristic for nature conservation as yet?

Germany has differentiated judicial instruments, from tree protection rules on a communal basis up to the convention on biological diversity. The core of these instruments is formed by concepts of a preserving, mostly static and regionally operating nature conservation. Together they form nature conservation's success story of the last century, esp. of the last decade. Will they be able to do so in future in the face of local and regional consequences of global climate change?

What should characterize nature conservation in future?

Assuming increasing dynamics of ecosystems mainly four requirements should be fulfilled:
- a network of large-area nature reserve should exist
- factors characterizing high resilience of ecosystems, as richness in structure, should be supported
- migration of species in response to climatic change must be made possible
- knowledge basis must be broadened

The instruments of nature conservation must react on the requirements of climatic change, must be adjusted if necessary. A good basis is already laid by the large-area impact instruments, like Natural 2000, the water frameworks directivity and wildlife corridors. Their importance will grow in the future. Consequently they should be implemented and qualified further. Yet additional efforts are needed to bring to reality the dynamic protection of biodiversity, postulated by Doyle and Ristow (2006). Moreover added research is essential.

Professional and political discussion with social actors, especially from agriculture, forestry and fishery, is essential. Without including these areas of utilization, especially outside the boundaries of protection areas, the success story of nature conservation will not be continued under the conditions of change.

Challenges for environment and nature conservation NGOs and the nature conservation volunteers

Not only instruments of nature conservation but also actors in nature conservation must react to the demands of climate change. The nature conservation prevailing up to now, following a mainly preserving idea, is built on a corresponding theoretical basis. This basis may need some adjustment under the impression of ongoing changes. Emotional attachment to nature is one of people's main motivation for engagement in nature conservation. If under the impression of climatic change one's own action for nature conservation is questioned either in its theoretical embedding or in its sense of meaningfulness, the result can easily be demotivation.

The NGOs' activities for environment education and communication will have to take this into account. Target group in this connexion is not only the federation's own volunteers but also all target groups of environmental education. Ultimately this must become a main topic of the federation's general public relations work. Up to now, developing public awareness in the field of climate change either for their members or for the general public has only just begun in the NGOs. Also outside the NGOs this is only marginal. Scientific and political discussions of the issue haven't been very applicatory so far.

All this may well lead to critical discussions in the field of volunteer nature conservation. Processes of consideration may result: How much effort for a certain species or another item of protection should be regarded as worthwhile. Ultimately, the answer might occasionally be, to do nothing. Without accompanying explication, this may lead to frustration and demotivation.

The same communicative challenges must be faced in the area of political participation.

CONCLUSION

- The current standing of nature conservation offers a good basis
- Demands on actors and instruments in nature conservation will grow
- Discussion is only just beginning – at least within the BUND. It will become one of nature conservation's central fields in the future. With the BUND biodiversity panels a beginning is made.
- Widely integrating analyses of endangerment and flexible concepts of action are needed.
- Including actors from economy and society will become more important then ever
- A good communication policy with citizen is essential
- In the end the strong alliance with the (international) climate protection- and energy policy will prove to be the central field of work of nature conservation as well.

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ENSCONET — A UNIQUE CONSERVATION TOOL TO MITIGATE CONSEQUENCES OF GLOBAL WARMING ON NATIVE PLANT SPECIES IN EUROPE

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Keywords: seed banks, ex situ conservation, networking, native plant species, Europe

THE DIVERSITY OF PLANTS IS ESSENTIAL FOR HUMAN WELL-BEING

The diversity of plants is essential for human well-being. However, this diversity of plants is under serious threat for many reasons. One urgent reason is climate change. In Europe, the vascular plant flora comprises about 12,500 species. The Mediterranean Basin is one of the world's biodiversity hot spots (Conservation International 2005), and Europe's Alpine zones are home to approximately 20% of all native European vascular plant species – about 2,500 species (Väre et al. 2003). Predictions say that the Mediterranean and Alpine floras of Europe will be particularly affected by climate change (Thuiller et al. 2005). High mountain plant species are particularly vulnerable to climate change because they are highly adapted to particular ecological niches and have narrow habitat tolerances. They often occur in small isolated populations, and are unable to migrate because of lack of suitable habitats at higher elevation.

There is some realisation that it is much cheaper to take preventive action than to repair the damage afterwards, and the importance of saving the world's plant diversity, rather than living without it, is internationally recognised: one of the Millennium Development Goals is to "ensure environmental sustainability" and to "reverse loss of environmental resources". The Convention on Biological Diversity in 1992 stressed the importance of plant species and their sustainable use.

THE ROLE OF SEED BANKS

Seed banks and other *ex-situ* conservation methods play an important role in an overall plant conservation strategy. Target 8 of the Global Strategy for Plant Conservation (GSPC) requires "60 per cent of threatened plant species in accessible ex situ collections, preferably in the country of origin, and 10 per cent of them included in recovery and restoration programmes" (CBD 2002). Seed banks act as an insurance policy against the extinction of natural populations (and, ultimately, species) and they provide material for bolstering or replacing those populations, and for conservation research. Seed banks are one important tool that help mitigate the consequences of climate change and global warming on native plant species.

EUROPEAN NATIVE SEED CONSERVATION NETWORK (ENSCONET)

The European Native Seed Conservation Network (ENSCONET, www.ensconet.eu), is funded to 2009 by the European Commission. The main purposes of the network are a) to improve quality, co-ordination and integration of European seed conservation practice, policy and research for native plant species and b) to assist EU conservation policy. It was initiated and is co-ordinated by the Royal Botanic Gardens, Kew (United Kingdom). It is the first time that seed banks and botanic gardens all over Europe are working together to bank the continent's native wild plant species. ENSCONET is directly relevant to both the CBD and to the GSPC's target 8 and contributes to achieving the goals of the European Strategy for Plant Conservation.

ENSCONET — STRUCTURE AND ACTIVITIES

The ENSCONET network co-ordinates seed conservation activities of its members and reduces duplicated effort in establishing and improving seed conservation methodologies. The network members share knowledge and technologies with the aim of helping less experienced members.

Its 24 full members are active in 17 European countries and cover all but one of the bio-geographical regions in Europe (Figure 1). In addition, several other European institutes belong to the network as associate members. The network activities are organised within four activity groups: Collecting, Curation, Data management and Dissemination.

ENSCONET promotes and develops common high standards for seed collecting and a co-ordinated, prioritised seed collecting programme for the European spermatophyte flora: in 2008, the network will publish a best-practice seed collecting protocol on the internet. Currently, the network members are comparing national and European flora checklists with the lists of holdings in the network's seed banks. This comparison is done separately for each of the bio-geographical regions in Europe and will lead to updated target lists for new seed collections of wild plant species. Already, the network's seed banks hold 36,600 accessions, representing 5200 European taxa (4500 species, 700 subspecies). In addition, there are 700 Macaronesian species banked. Some 1770 species are provisionally listed in one of the IUCN Red List categories. That means that ENSCONET holds samples of 35% of the total European flora (excluding the Canary Islands), and of more than half of an estimated 3500 threatened plant species in Europe (Figure 2). While good news, there is still much to be done: these numbers will raise steadily in future as members target new collections.

The activities of the curation activity group complement those of the collecting group. One of the first activities in the curation activity group was to gather data on European seed conservation facilities and resources. In total, more than 200 researchers and technicians are directly involved with the network activities. As part of their research activities, 13 seed banks perform regularly seed germination tests. Based on this information, the network aims to: look for resource gaps across the continent; produce guidance on curation protocols; and share expertise and facilities.

All data on banked species (including data on sampled locations, germination data and storage conditions), are being assembled within an ENSCONET database. The structure of this database was finalised at the end of 2006 and has already been populated with data from several partners; the other partner's data are currently being assembled ready for tidying. The idea is to have a virtual European native species seed bank ready by 2009, not only for use for the member institutes but linked to other external databases, and available online for researchers and other interested people all over the world.

Finally, the dissemination activity group aims to provide a better public understanding of seed banking and its importance for conserving native plants. Two key vehicles for this are an annual publication called ENSCONEWS and its website.

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FIGURE 1. Red dots show the locations of the 24 full network members from 17 European countries. These 24 institutions cover 9 bio-geographical regions in Europe (map basis: EEA map of Biogeographical regions, version 5, 2001, EEA Copenhagen)

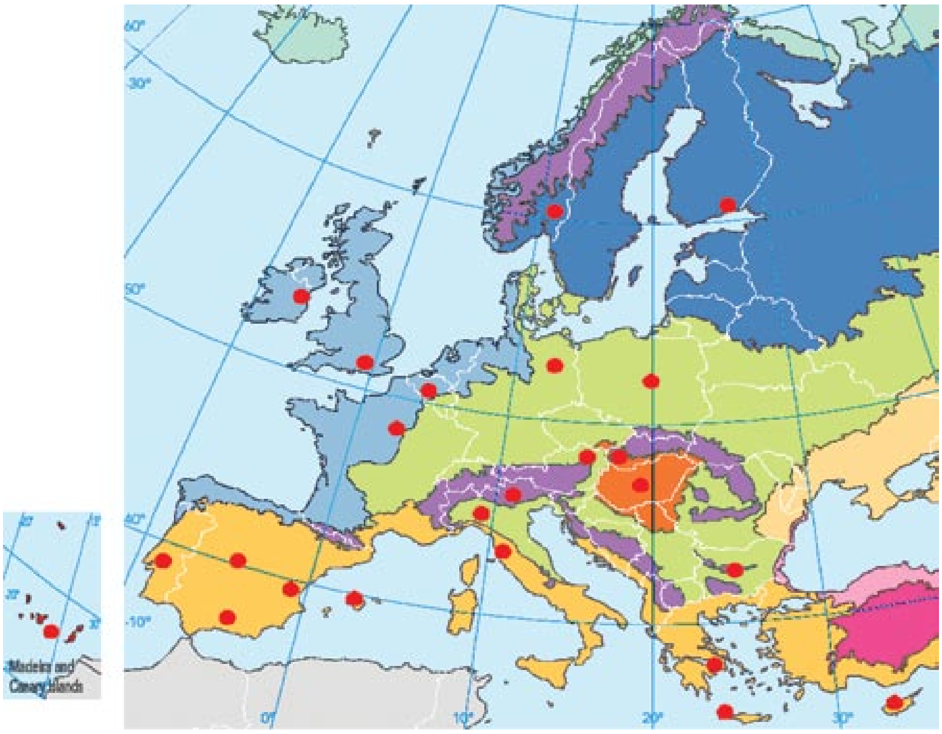

FIGURE 2. Long-term storage of native plant seeds in the seed bank of ENSCONET partner UPM (Spain). Photo: José M. Iriondo

THE EXPANSION OF MEDITERRANEAN DRAGONFLIES IN EUROPE AS AN INDICATOR OF CLIMATIC CHANGES — EFFECTS ON PROTECTED SPECIES AND POSSIBLE CONSEQUENCES FOR THE NATURA 2000 WEB

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Keywords: dragonflies, climate change indicators, vulnerability, NATURA 2000, Europe

INTRODUCTION

Dragonflies are good indicators for the quality of aquatic environments and also for environmental changes (Corbet 1999). Consequently they are also used recently as monitoring organisms to demonstrate the effects of climatic changes, e.g. via the range expansion of southern species to the north or via the shifts within communities (Ott 2001, Ott 2007 a, b, Hassel et al., 2007). As Mediterranean species move more and more to the north, they increase in these northern countries the biodiversity. But this may have consequences for other species, which prefer other — the former — environmental conditions. Here the first results of a study carried out during the last two years — and still ongoing for the next two years — in the transboundary biosphere reserve "Pfälzerwald-Vosges du Nord" are presented, where the effects on NATURA 2000 biotopes are investigated. These studies may serve as an example for future and similar processes of biotope changes and the endangerment of species and protected areas in Germany and Europe.

SPECIES, BIOTOPES AND CLIMATE

The dragonfly fauna and the environmental conditions of more then 20 waters — mainly dystrophic lakes (NATURA 2000-code 3160, see also Roweck et al., 1988) — were monitored in 2005 and 2006 and compared with previous investigations of these waters (e.g. Niehuis 1984). The dragonflies were investigated during the entire vegetation periods while visiting the waters in minimum at 3 good days and by observing and/or catching the adults and by collecting exuviae to proof autochthony. During these visits also the abiotic conditions of the waters and in the surrounding were registered and information on the use in the catchment area were collected (e.g. groundwater extraction). Climatic data were obtained from official climatic stations (e.g. www.agrarinfo-rlp.de).Nearly all of these waters are part of the national NATURA 2000 network and / or they are protected by the federal nature conservation law.

EFFECTS ON DRAGONFLIES AND BIOTOPES OF THE WEB NATURA 2000

The climatic data of several climatic stations in the investigated area show a clear trend to warmer temperatures — in comparison to the long-term mean ca. 1-1,5 ° C. — and to more extremes in precipitation in the last years. In particular the dry summer of 2003 is remarkable: after years with higher precipitation in comparison to the mean, this year had a precipitation about 30-40 % lower then the mean. These data are in concordance with recent studies (Zebisch et al., 2005, UBA 2007).

As a consequence of the conditions in 2003 the water level in the waters dropped down about 1 – 2 meters, depending on the local situation (e.g. geology and size of the catchment area, biotopes in the surrounding) and also the nearby situated wetland biotopes dried out. This lack of water could not been filled up in the following 3 years and the water table sank even more (see Fig. 1). This lead to a much smaller water body having no more contact to the vegetation at the shoreline and also wide open areas around these waters came into existence.

As a consequence of these abiotic changes and in some cases also because of synergistic effects (e.g. ground water extraction) the ecological quality of these vulnerable waters changed dramatically and so their value for the different dragonfly species. Within very short time most of the stenoecious and endangered moorland species, which are characteristic for the dystrophic waters (sensu Ssymanck et al., 1998), could not anymore be registered from most of the waters (e.g. *Somatochlora arctica, Aeshna juncea, Leucorrhinia dubia, Coeangrion hastulatum*). They are now also nearly extinct for the German part of the biosphere reserve: e.g. for *Somatochlora arctica* only one population is left, being highly isolated. On the other hand these waters were colonised in the same time by euryoecious and ubiquitous species, which are now dominating the coenosis (e.g. *Anax imperator, Orthetrum cancellatum, Libellula depressa*) and indicating the strong disturbance. Some of these waters were colonised by protected species, such as *Lestes barbarus*, but also this fact is more an indicator for the little ecological value of the waters, as this species is typical for astatic waters (Ott 2007 c), Some of the waters even dried out completely and so lost totally their value for any aquatic fauna, not only for the dragonflies.

If no changes of the climatic conditions will occur, what could be expected (Zebisch et al, 2005, UBA 2007), in the future the waters and so the NATURA 2000 network will loose its value completely.

The invasion of southern and eurytopic species becomes obviously a general process in Germany and Middle and Northern European countries indicating the disturbance of the waters (Ott 2007 b), as well as the lack of water in many countries and regions (Italy, Spain – Germany: e.g. the federal state of Brandenburg). Consequently strong changes within the European dragonfly fauna could be expected. Especially the species of moorland biotopes, springs, small brooks and alpine regions will face a strong decrease and in some regions also extinction.

In the longer term this process will lead more to a decrease of biodiversity then to an increase and to a devaluation of the web NATURA 2000.

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FIGURE 1: The "Kolbenwoog": a dystrophic water nearly dried out between 2003 and 2006: typical moorland species left and euryoecious species invaded this biotope, being part of the NATURA 2000 web (NATURA 2000-code 3160).

FIGURE 2: *Crocothemis erythraea*: a mediterranean species, which colonised Germany in the last 3-4 decades from south to north. It indicates the climatic effects on the waters, as well as their disturbance. This process could also be observed in many other middle and northern European countries, and meanwhile several other southern species are following, leading to changes in the whole coenosis of the waters.

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HOW TO ADAPT NATURE CONSERVATION STRATEGIES TO CLIMATE CHANGE

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CLIMATE CHANGE AND BIODIVERSITY

Climate change is exerting distinct impacts on ecosystems at different scales: At the scale of individual plant and animal species, changes in bioclimatic conditions may cause local extinctions of those species that are adapted to cold or wet conditions. Species from warmer regions may colonize formerly temperate zones. At the community scale plants and animals will likely form new assemblages. At the ecosystem scale, carbon and water cycling may change, resulting in altered ecosystem functions and services (e.g. Schröter *et al*. 2004; Lucht *et al*. 2006).

NATURA 2000 IN EUROPE

Within the framework of the Habitat and Bird Directives of the EU, the Natura 2000 network aims to protect different habitat types and species, with a heterogeneous extent of implementation with respect to size and connectivity throughout Europe. In this context two related research projects are funded by the German Federal Agency for Nature Conservation that aim at developing conservation approaches that follow the precautionary principle.

Climatic risks for selected plant and animal species are quantified applying statistical as well as process-based simulation techniques. The risk to miss the specific conservation targets assigned to special protected areas is assessed for a comprehensive and representative list of German sites.

Preliminary results indicate that in the long run plant and animal species in some cases cannot be conserved in the protected areas where they are currently occurring. Protected areas differ in their risk to reach conservation aims depending on the strength of regional climate change impacts, on the percentage of climate sensitive species, on water relations, and on the character (static *vs* dynamic) of their aims, among others.

Based on the results, recommendations for adaptation of nature conservation strategies towards more dynamic approaches are formulated at several scales in close dialogue with stakeholders (Fig. 1). Strategies include management aspects such as a reduction of stressors, e.g. chemicals or artificial water regimes. Ecological coherence must be achieved in a large-scale European context to ensure dispersal and migration. As the environment changes are occurring at a rapid pace, special attention is dedicated to the communication of adapted management strategies. Conservation targets have to be more dynamic while aiming at ensuring the support of local stakeholders.

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Further information

Project "Protected Areas in Germany under Global Change - Risks and Policy Options": http://www.pik-potsdam.de/vme/schutzgebiete

Project "Modelling the Impact of Climate Change on Plant Distribution in Germany": http://www.ufz.de/klimawandel-flora

FIGURE 1: Adaptation nature conservation strategies based on a regionalized risk assessment needs to combine management strategies at different scales as well as communication strategies.

HABITATS FORESTIERS MENACES EN ZONES MARGINALES D'ALGERIE

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Mots clés : Algérie, systèmes forestiers, habitats marginaux, menaces
Key words: Algeria, forests ecosystems, marginal habitat, threat

RÉSUMÉ

L'action historique de l'homme a fortement marqué les paysages du Maghreb. Les chaînes atlasiques notamment méridionales, qui ont abrité les plus anciennes sociétés montagnardes, Berbères, Romaines; … ont ainsi connu une réduction et un changement de leur végétation forestière. L'utilisation de l'espace durant ce siècle dernier associée à la péjoration climatique et à l'accroissement démographique a gravement accéléré cette dégradation de sorte que les paysages forestiers sont devenus résiduels notamment dans la partie occidentale de l'Atlas Saharien.

Par ce travail, nous donnons une description de ces îlots forestiers, situées en limite méridionale (habitat marginal) et qui doivent être préservés comme derniers témoins. Leur alarmante fragmentation et leur substitution par une végétation steppique mieux adaptée à ces conditions drastiques soulignent l'incertitude de leur existence.

L'analyse de ces formations végétales, comme élément de diagnostic indispensable à l'engagement d'une politique de gestion, illustre les changements observés au niveau des caractères écologiques ainsi que de la structure de la végétation et de la composition quantitative et qualitative de la flore, en réponse à ces conditions de stress induites par les changements climatiques (tendance à l'aridification) et les perturbations. Elle attire notamment l'attention sur la précarité de l'équilibre de ce type de végétation relictuelle, à haute valeur écologique et économique et sur l'urgence de freiner cette détérioration du patrimoine végétal et édaphique hérité de périodes anciennes et non renouvelable dans les conditions actuelles de milieu et encore moins dans les conditions à venir si on tient compte des perspectives de changements climatiques et d'accroissement de la population.

THREATS AND CHALLENGES TO THE TRAVELLERS OF THE NATURAL WORLD

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Keywords: migratory species, climate change, biodiversity, endangered species, conservation

INTRODUCTION

Our climate is changing: the global mean surface temperature is rising, regional precipitation patterns are being altered, sea levels are rising, floods, drought and storms are occurring more often. While nature conservation has to cope with new challenges and other well-known pressures, animals, ecosystems, economic systems and people continue to be affected.

As part of wildlife affected by climate change, migratory animals appear to be particularly vulnerable as they use multiple habitats and sites as well as a wide range of resources at different points of the migratory cycle. The impacts of climate change are seen to affect their migration routes, habitats, feeding, breeding & reproduction and influence diseases, experienced differently by different species.

The United Nations Environmental Programme (UNEP)/ Convention on Migratory Species (CMS) is the only global agreement addressing specifically the needs of animals on the move. Climate change and its direct and indirect effects are becoming an ever more important aspect of the Convention's work.

IMPACTS OF A CHANGING ENVIRONMENT ON MIGRATORY SPECIES

Changes in migration routes and barriers to migration

Adverse climate changes have led to alterations in length, timing and location of migration routes. This has resulted in certain cases in species migrating either earlier than expected or to areas where they have not been recorded other than as occasional vagrants, and in extreme cases species have abandoned migration altogether. For instance in Germany the European bee eaters (*Merops apiaster*) once very rare are now breeding regularly across the country.

Where long migration journeys are traditionally less common and more unpredictable, species may have to migrate more often in search for food and water; not only increasing their danger but also the difficulty in assessing and ensuring their conservation. An example being terrestrial mammals such as the Mountain gorilla (*Gorilla gorilla beringei*) (Defra, 2005).

Habitat changes

Climate-induced changes in habitat are predicted to be greatest in the Arctic where options for range shift are reduced due to limited availability of land at high latitudes and altitudes. There is also increased competition and displacement of habitats amongst species in these regions. The increase in temperatures of the North Sea has resulted in the presence of exotic southern fish like the Red Mullet, Anchovy and the Poor Cod, whose distribution and abundance are temperature dependant (exothermic), while on the other hand species like the Pacific oysters (*Crassostrea gigas*) are able to breed, displacing native oysters in the Wadden Sea. (UNEP, 2006).

Feeding

Climate change is affecting migratory species by influencing the availability of their prey; an example is the negative impact of climate change on availability of Sandeels. Studies reveal that the decrease in availability of Sandeels in spring might increase the likelihood of starvation on harbour porpoise (*Phocoena phocoena*) populations of the North Sea, as they are one of the most important prey items. (MacLeod *et al.*, 2007)

Abundance and quality of prey species are important, especially in stop-over sites adjacent to major barriers such as the Sahara desert and on the breeding sites.

Breeding and Reproduction

The rise in mortality rates of migratory species due to climate change has a knock-on effect on reproduction and breeding. The El Niño Southern Oscillation in 1982 resulted in the loss of an entire year of Galapagos seal (*Arctocephalus galapagoensis*) pups and abnormally high mortality rates among juvenile sea birds.

The rise in sea levels especially at low elevation sand beaches, increase in storms, combined with the impacts of erosion and flooding of nesting habitat can lead to a higher proportion of nest destructions on nesting beaches e.g in the case of turtles. (Limpus, 2006)

Changing temperature also affects reproduction of cetaceans and pinnipeds either by extending the time between individual breeding attempts or by reducing breeding conditions of the mother. An interesting observation is the feminisation of populations. This is rather evident with the sex ratio of the turtle hatch that is temperature-dependent in both the Dermochelyidae and Chelonidae families. Higher temperatures in the range 25-32^{o}C lead to a greater number of female young (and lower temperatures to more males). An imbalance in the male: female ratio of 1:2 or 1:3 has no ill effect but if the proportions move towards 1:4 then populations may be adversely affected. (Defra, 2005)

Incidence of disease

Many diseases and parasites thrive in higher temperatures impacting more profoundly on the populations of their target prey. Global warming may foster poisonous algal blooms and contribute to epizootics resulting in mass die-offs of marine mammal populations. (Simmonds and Isaac, 2006) As much as viruses have been identified as the cause, environmental factors have contributed and influenced these epizootics.

PRIORITIES FOR CONSERVATION

Various steps can be taken to ensure that migratory species cope better with a changing climate. These include adaptive measures that may reduce impacts and threats to migratory species, such as, the creation of suitable migratory habitats (like wildlife friendly margins, hedgerows, small copses and ponds), maintenance of a consistent network of quality stop-over sites and maintenance of large population sizes to ensure the presence of sufficient genetic variation. There is also a need to manage human impacts on species resources e.g. the designation of marine protected areas. (Robinson *et a*l., 2005)

CMS ACHIVEMENTS AND PLANNED PROJECTS

Resolution 8:13: Climate change and Migratory Species

During the 8th meeting of the Conference of Parties in November 2005, Resolution 8.13: *Climate Change and Migratory Species* was adopted. Based on this, the Convention was set to work with the Scientific Council and secretariats of the CMS daughter agreements to produce guidance that would help CMS parties introduce adaptation measures to help counteract the effects of climate change on migratory species. It also encourages the initiation of collaborative international research projects into the effects of climate change on migratory species and their habitats so as to better understand implications and appropriate policy responses.

Development of an intersessional working group and further research

In light of this, at the recent 14th Scientific Council meeting that took place on 15 March 2007, an intersessional working group on climate change was established. The study on climate change and migratory species carried out by the British Trust for Ornithology found out that there was a clear link between climate change, altered behaviour in birds and changes to species' range and abundance. Ten proxy species had been identified and projections could be made for some other species.

A further study supported by the UK government (Defra) is expected to start in April 2007, with two main aims; (i) identify a set of species whose attributes can act as indicators of likely climate change impacts on the range of migratory species and (ii), develop standardized international protocols for monitoring the effects of climate change on populations of these migratory indicator species.

Production of Publication

The production of the publication "*Migratory Species and Climate Change: Impacts of a changing environment on Wild Animals*", in collaboration with UNEP and DEFRA was aimed at raising awareness by highlighting case studies, assessing impacts and identifying possible solutions and mitigation measures of the effects of climate change on migratory species. The publication, containing contributions from experts around the world, also identifies the need for coordinated research, monitoring and conservation throughout a species range, something for which CMS provides the ideal framework. The publication is available at: http://www.cms.int/publications/pdf/CMS_CimateChange.pdf.

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EFFECTS OF CHANGES OF CLIMATE AND ATMOSPHERIC COMPOSITION ON BIODIVERSITY OF AGROECOSYSTEMS

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Keywords: soil biodiversity, soil mesofauna, carbondioxide, ozone, FACE

CLIMATE CHANGE RELATED TO BIODIVERSITY IN TEMPERATE REGIONS

According to present knowledge, the dynamic of biodiversity issues and climate change are directly linked. Limits of variability and adaptability on different scales of genotype, species composition, population size and ecosystem functions are related to matter input, water regime, temperature variation and radiation.

The main aspects of present and future climate change in temperate regions concern:
- Increase of mean annual temperature.
- Increase of heat stress frequencies and drought stress periods in summer.
- Increase of winter and decrease of summer precipitation.
- Increase of concentrations of atmospheric carbondioxide (CO_2) and tropospheric ozone (O_3).

These changes may cause loss of biodiversity. Furthermore, the impact of climate change may affect biodiversity functions due to modified genotypes, species composition and individual densities. Monitoring measures in manipulative field experiments and agroecosystem modelling are suitable tools to improve our understanding of complex feedback loops during coming climate scenarios. Comprehensive overviews on scientific developments, results and models were recently published in Canadell et al. (2007).

FUNCTIONAL CHANGES OF BIODIVERSITY IN AGROECOSYSTEMS DUE TO CLIMATE CHANGE

In agroecosystems, nutrient cycles are mainly controlled by human management and by functional aspects of biodiversity. Furthermore, agroecosystems are part of climate change dynamics by consumption and production of greenhouse gases.

Changes in the chemical composition of the atmosphere may modify biodiversity and its functional roles at different levels:
- Plant genetic resources: Cultivation of new or old cultivars and production of modified geno- and phenotypes support adaptation processes of crops to changing climate conditions.
- Beneficial and pest organisms: Modifications of host plants, crop rotations and management may affect pollinators, pest organisms and their antagonists.
- Soil biodiversity: Modifications of the community structures of soil microorganisms and soil fauna may be the consequence of changed quality and quantity of rhizodepositions and crop residues as well as changed soil water regimes.

FIELD EXPERIMENTS TO ASSESS IMPACTS OF CHANGES IN ATMOSPHERIC CHEMISTRY ON SOIL BIODIVERSITY

In Braunschweig (Northern Germany), field experiments on arable land were established to assess ecological aspects of chemical changes in the atmosphere (elevated CO_2 and O_3) on the plant-soil system. The ecological importance of both greenhouse gases is studied separately. Fig. 1 (left hand) shows the experimental design of a FACE plot (Free Air Carbondioxide Enrichment), where elevated CO_2 is applied into the standing crop (550 ppm) compared to control plots with ambient air (380 ppm) (for details see Weigel et al. 2006). The second field experiment is conducted using open-top chambers (Fig. 1 right hand) to study possible effects of elevated O_3 concentrations (60 ppb above ambient concentrations).

In both field experiments, soil biodiversity is one subject of investigation. The so-called mesofauna comprises mainly collembolans (springtails), mites and enchytraeids (potworms), which are important members of the soil food web. They are main drivers of catalyzing microbial activity, which promotes and accelerates decomposition and mineralisation rates of dead organic matter. Greenhouse gases like CO_2 and O_3 may affect soil organisms indirectly via root exudates and plant residues.

Under elevated atmospheric CO_2 concentrations, an increase in species richness and individual density of collembolans was found (more details in Sticht et al. 2006). In case of enchytraeids, the results depend strongly on the cultivated crop leading to increased or decreased individual densities under elevated CO_2 concentrations. First results under elevated atmospheric O_3 concentrations reveal depressions of abundances of all three mesofauna groups (collembolans, mites and enchytraeids).

Examples like the results of the present field experiments clearly demonstrate that changes in the atmospheric composition may exert indirect effects on the soil system via effects on primary production. With this in mind, changes in soil biodiversity are bottom-up controlled which may cause changes in the delivery of ecosystem services like release rates and quality of plant nutrients through decomposition.

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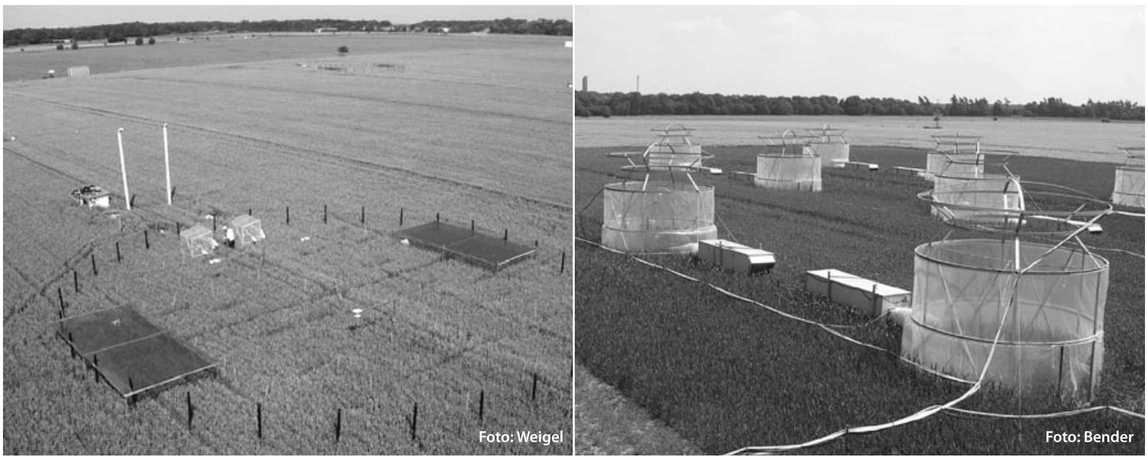
FIGURE 1. Field experiments on atmospheric climate change effects in agroecosystems at the Federal Agricultural Research Centre in Braunschweig (Germany) considering soil biodiversity. Left: One plot of the FACE (Free Air Carbondioxide Enrichment) experiment. Right: Open-top chambers to study effects of elevated ozone (O3) concentrations.



NATURAL HISTORY COLLECTIONS: THE ULTIMATE BIODIVERSITY ARCHIVE

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Key words: Natural history collections, Taxonomy, Biodiversity, Systematic biology, CETAF

NATURAL HISTORY COLLECTIONS AND TAXONOMY: SOURCES AND TOOLS TO DOCUMENT IMPACT OF CLIMATE CHANGE ON BIODIVERSITY

Taxonomy is a basic science of fundamental importance for understanding biodiversity and ecosystem functioning. It deals with exploring and describing Biodiversity at the species level, through scientific analysis and a heuristic organisation of biodiversity data linked to these organisms. Taxonomy allows reporting on Evolution and reconstructing the history of Life on Earth and through this information to address the impact of climate change on Biodiversity.

Taxonomic knowledge is managed, extracted and stored in natural history collections, which are simultaneously object, tool and product of research in Biodiversity. But natural history collections also support the objectives of numerous other user communities such as in agriculture, fish-farming, forestry and horticultural industries, eco-tourism, water-quality, conservation and sustainable use, food traceability, pharmaceutical and drug companies.

European taxonomic facilities manage and give access to some 1,5 billion specimens of more than 80% of the described species from all parts of the world thanks to half of the world's biological collections. These collections are distinguished by their richness in type (or reference) specimens, especially those of the World's most common and economically important organisms. They allow a direct access to organisms, to their occurrence and to their associated biological, geographical and etho-ecological associated data. They preserve the witness for the study of evolution of organisms and to their genetic variation in time and space.

Representing the ultimate biodiversity archive, European natural history collections are organized through CETAF, the Consortium of European Taxonomy Facilities. Together, these European collections constitute a unique major distributed research infrastructure, which holds a substantial part of the knowledge and data necessary:
1. to remove the "Taxonomic impediment" as recognized by CBD in 1998,
2. to document indicators of biodiversity (richness, distribution, variation in time and space,…)
3. to measure through these indicators the impact of climate change on Biodiversity.

CETAF OBJECTIVES

CETAF, the Consortium of European Taxonomy Facilities, was founded by ten of the largest European taxonomic institutions (natural history museums, botanic gardens and other biological collections) in 1996 to promote scientific research and access to European collections, and to be the voice for Taxonomy and Systematic biology in Europe. Today CETAF represents 28 members.

CETAF strives to:
- maximise the benefits that its member institutions can provide for the sustainable use of Biodiversity in Europe and elsewhere in the world;
- coordinate work around the field of taxonomy with other institutions, governments, private organisations and agencies;
- improve Europe's capacity to fulfil its commitments and obligations in taxonomy under European and international initiatives such as the Global Biodiversity Information Facility (GBIF) and the Global Taxonomic Initiative (GTI) as well as conventions (especially the CBD).

CETAF wants to:
- promote increased access to collections and associated information
- provide international leadership in setting and implementing standards for collections
- exploit new scientific opportunities to provide new knowledge
- secure Europe's taxonomic capabilities

CETAF ACTIONS AND INITIATIVES

To reach its objectives CETAF or its members exploit European funding opportunities through various initiatives. CETAF members have been involved in several earlier projects such as:
- ENBI: European Network for Biodiversity Information, which aimed at making biodiversity data accessible through an integrated shared information infrastructure.
- FAUNA EUROPAEA with the objective to assemble a database of the scientific names and distribution of all living multicellular European land and fresh-water animals. More than 400 contributing specialists compiled the first list on more than 135 000 non-marine species of European animals.
- Euro+Med PlantBase, the botanical counterpart of Fauna Europea, , now an on-line database and information system for the vascular plants of Europe and the Mediterranean region.
- BioCASE: A Biological Collection Access Service for Europe. This project has its roots in CETAF and its aims was to establish a web-based information service providing users with unified access to biological collections in Europe.

CETAF has been directly involved as a consortium in the major European network
- ENHSIN: European Natural History Specimen Information Network which had the aims to enable the development of a shared, interoperable infrastructure of natural history specimen databases in European institutions.

Also funded by the European Commission, EC, CETAF has also initiated two on-going projects around its four major keywords: *Access, Standards and best practices, Cybertaxonomy* and *Training*:
- SYNTHESYS: Under the 6^{th} framework CETAF institutions are currently running an Integrated Infrastructure Initiative SYNTHESYS, Synthesis of Systematic Resources,. The project provides transnational access to European taxonomists to member facilities and networking activities focus on complementarity and gaps analyses, collections standards, enhanced data processing, new types of collections and new analytical methods in taxonomy. The Natural History Museum of London is the leader of this CETAF initiative.
- EDIT: The most recent initiative from CETAF is EDIT 'Toward an European Distributed Institute of Taxonomy', a Network of Excellence led by Museum national d'Histoire naturelle de Paris. It is built around three major items:
- Integration of research activities in Taxonomy in a globalized digital environment for best management of already acquired knowledge and acquisition of new knowledge,
- Sustainability of taxonomic facilities and resources, and maximised benefit from their use through agreements at institutional, European and international levels,
- Dissemination and access to knowledge via training and capacity building.

As a voice for Taxonomy and Systematic biology in Europe, CETAF strives to use the Framework Programmes of the EU to boost taxonomic research in relation with major international initiatives. Particularly, CETAF is fully committed to the GBIF objectives and participates at various levels to the global taxonomic effort. Currently, CETAF is a co-initiator of:

- Life Watch, a new plan of the main European biodiversity science networks, aiming at constructing a virtual laboratory with access to data (from GBIF and from monitoring sites) and to analytical and modelling tools. It will serve to support scientific research, policy makers and the public for undertsanding and the management of our ecosystems on land and in the seas. Through LifeWatch, CETAF will provide the European taxonomic documents and analysis of impact of climate change on Biodiversity.

CETAF — THE VOICE FOR TAXONOMY AND SYSTEMATIC BIOLOGY IN EUROPE

CETAF wants to champion the importance of the science of taxonomy in its crucial role in base-line biodiversity research, and in the development of its sustainable use and conservation of Earth's living resources. By gathering and giving access to biodiversity data from the distant and recent past, documented in natural history collections, and by exploring and describing both the past and the present, CETAF institutions contribute to the understanding of the impact of climate change on biodiversity and helps to provide the basic data for predicting models to better understand and manage the future.

More information about CETAF can be found at the website www.cetaf.org.

ADAPTION STRATEGIES OF SOIL FUNCTIONS TO CLIMATE CHANGE IN GERMANY

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Keywords: climate change, soil function, agriculture, vulnerability, erosion

INTRODUCTION

In the recent past it was undoubtedly noticed, that human activities lead to a change of climatic conditions, which will impair e.g. sea level, aquatic resources, food production, biodiversity. Furthermore, a changing climate will probably affect some essential soil functions.

The aim of the present study - on behalf of the Federal Ministry for the Environment, Nature Conservation and Nuklear Safety (BMU) and the Federal Environmental Agency (UBA) - is to estimate the impacts of a future climate on arable soils in Germany and their functions in the natural balance and for the productivity with respect to human needs. The study contributes to the National Climate Protection Programme, adopted on 13th of July 2005. With the programme the Federal Government intends to point out the need for action for those sectors which are not part of the emission trading, and to investigate concepts for the adaptation to climate change.

PROJECTIONS OF A CHANGING CLIMATE IN GERMANY

For the wide range of Intergovernmental Panel on Climate Change (IPCC) emission scenarios, the earth's mean surface temperature is projected to warm 1.8 to 4.0 °C (IPCC, 2007) by the end of the 21st century, with different warming of land and oceans, and with different consequences for the high latitudes and the tropics. Precipitation is projected to increase in some areas and to decrease in others, generally more heavy precipitation events.

Based on the findings of General Circulation Models (e.g. ECHAM5) several regional models have been developed to project changing temperature, precipitation, wind speed, or global radiation, respectively, on a local level. Beside others, the regional model $REMO_{EC4}$ (developed by the Max-Planck-Institute of Meteorology, MPI) focuses on the area of Germany with a horizontal resolution of 10x10 km.

First results of the calculations with REMO show a varying change in temperature and precipitation for the north, the east and the south of Germany. For example, while air temperature in the alpine region (south of Germany) is projected to increase by 4-4.5°C in 2071-2100 compared to 1961-1990, the increase in temperature in the upper north and east is projected to 2-3°C (Figure 1). Furthermore, precipitation is projected to increase in the south (specially in winter months) and to decrease in the east (Figure 2).

VULNERABILITY OF SOIL FUNCTIONS IN A CHANGING CLIMATE

Among other countries, in Germany soils and their functions are protected by law (*Federal Law On Soil Protection*). Table 1 gives an overview on the classification of functions and sub-functions or criteria in german soils. Several methods for every sub-function or criteria exist, which are used in administration and planning offices, to calculate or to estimate the potential of a given soil.

In the present study, methods for arable soils were selected, which take into consideration climatic parameters beside of soil parameters. For example, to calculate the risks for water erosion (Table 1: soil function 6, sub-function 1) or the formation of ground water (Table 1: soil function 2, sub-function 2) parameters from well monitored soil areas were used, such as soil type and texture, soil density, carbonate content, humus content, pH value, field capacity, hydraulic conductivity, root development depth, soil moisture, ground water level, content of silt and clay, inclination, crop type and crop rotation, and farming practices, rescpectively.

The findings indicate that the risks for soil erosion are projected to increase in particular in the hilly south of Germany, and that the formations of ground water are projected to decrease especially in the east of Germany. Among the serious consequences for agriculture would be a loss of fertile top soil and humus on the one hand, and a drying up of the soil body and a missing water supply for farm crops on the other hand. In any case, a degradation of soil quality and soil functions is assumed.

AGRICULTURAL PRACTICES TO REDUCE GREENHOUSGAS EMISSIONS

Soils are not only victims of climate change but arable soils themselves are known to be responsible for approximately 80% of man made nitrous oxide (N_2O) emissions. On the other hand, sustainable agricultural practices can lead to a reduction of the emissions of N_2O, methane (CH_4), and carbon dioxide (CO_2) - for example, minimum tillage, prevention of soil compaction, catch-crop growing, companion planting, mulching, adapted fertilization.

Furthermore, it is discussed to establish specific management practices to intensify carbon storage in the humic substance to reduce the atmospherical load with CO_2. Nowadays, calculations on humus accumulations under a changing climate are still in progress and will be worked out in the present study.

The cultivation and use of biomass for energy production is assumed to reduce the emissions of greenhouse-gases. But, a rigorous expansion of land use might affect ecosystems, regional material flows, and land scape functions and soil functions. Sustainable management practices for the production of renewable raw materials must be developed and adapted to protect not only climate but soils as well.

Most of the agricultural methods mentioned above and others are well proofed and investigated, but not widely known in the context of climate change. It is requested to develop toolkits for agricultural best practices by research institutions, as well as agricultural organisations, administrations, or policymakers, and to train farmers on sustainable land use to preserve soil functions and to reduce greenhousegas emissions.

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FIGURE 1. Differences of air temperature (2 m height) in Germany in the annual average between the measured period 1961-1990 and the calculated period 2071-2100 (scenario A1B).

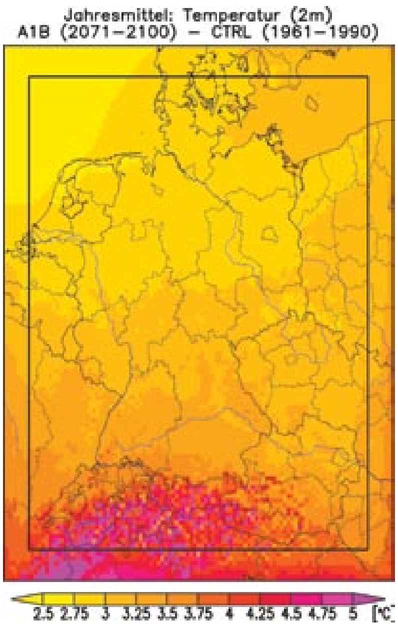
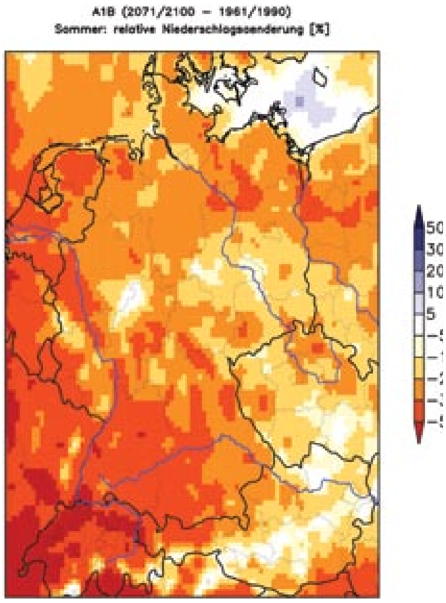


FIGURE 2. Differences of precipitation in Germany in the annual average between the measured period 1961-1990 and the calculated period 2071-2100 (scenario A1B).



Calculations were done by the Max-Planck-Institute of Meteorology (MPI), Hamburg, using the regional CC model REMO. Figures by courtesy of Dr. Daniela Jacob, MPI, (available from http://www.mpimet.mpg.de).

TABLE 1. Adapted and summarised overview of the soil functions given by the *Federal Law On Soil Protection* and by the Committee on Soil Research (BLA-GEO) and the Working Group on Soil Protection (LABO) of the Federal Republic and the States (Laender) of Germany (BLA-GEO & LABO, 2003).

No.	Soil Function	Sub-Function or Criteria
1	Living Space	• Basis for Human Live • Potential for Plant Societies • Natural Soil Fertility • Habitat for Soil Organisms
2	Natural Balance	• Regulation of Drainage • Formation of Groundwater • Water Balance • Potential for Nutrients and Availability for Basic Cations
3	Decomposition, Regulation and Composition	• Potential for Binding of Heavy Metalls • Potential for Binding of Organic Pollutants • Potential for Buffering of Acids • Storage of Soil Water • General Filter Functions
4	Archive of Nature and Culture History	
5	Deposit of Raw Materials	
6	Non-Material Risks	• Water Erosion • Wind Erosion • Soil Compaction

IMPACTS DE LA SECHERESSE SUR LES ECOSYSTEMES NATURELS DES VILLAGES CÔTIERS DU SUD-OUEST DE MADAGASCAR

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Mots clés : sècheresse, menaces, Sud-Ouest Madagascar, adaptation, communautés locales

RESUME

A. Une diversité des écosystèmes et des espèces fortement menacée.

La biodiversité du Sud Ouest de Madagascar est mondialement connue, de part ses richesses en biodiversité terrestre: forêt sèche endémique du Sud Ouest, côtière, mangroves et marine, récif de Toliara.

Par contre, malgré ses richesses, les études et observations ont montré que ces écosystèmes déjà très vulnérables, sont exposés à des dégradations de plus en plus accrues.

Les récifs s'étendent sur plus de 200 kilometres de longueur et compte 5000 espèces. Sur 81 espèces endémiques à un ou plusieurs sites dans l'Ouest de l'Océan Indien , au moins 24 sont retrouvées au niveau des récifs de Toliara et 4 sont endémiques à Madagascar. Toutefois, il s'agit également de la zone constituant les principales ressources économiques de la région donc le milieu le plus prisé et le plus exploité.

En l'espace de 40 ans (1970–1997) le nombre des espèces sur le Grand récif de Toliara a diminué de 62,3 % (SPROGES).

Des efforts sont actuellement menés afin de conserver les sites encore en bon état, se traduisant par la mise en place de l'aire protégée marine et côtière.

La Forêt sèche du Sud représente une très forte endémicité mais elle est également la plus fragilisée car sa reconstitution après la perte de sa couverture est très difficile (Razanaka, 2002). Le défrichement de la forêt pour la culture constitue le premier facteur de dégradation de la forêt, vient ensuite le charbonnage.

Les mangroves sont évaluées à un peu moins de 990 ha sur tout l'ensemble du littoral Sud Ouest (SPROGES, 2006). Bien qu'étant moins importantes que celles se trouvant dans les régions Ouest de Madagascar, elles jouent néanmoins un rôle primordial dans le maintien de l'équilibre de l'environnement de la région déjà fragilisé, en tant que zones de nurseries, de frayères et d'alimentation pour des espèces d'importance commerciale. Malheureusement, elles sont menacées de part deux principaux facteurs, dont le défrichement pour les besoins en bois de chauffe et l'ensablement par la sédimentation. Le taux de couverture des forêts de mangroves n'est plus que 56% sur tout le littoral Sud Ouest (ONE, 2000).

B. Intensification de la sécheresse

Le climat du Sud-Ouest est naturellement de type sub-aridité marqué notamment par des déficits des pluies, des variations locales et une répartition inégale au cours de l'année de la pluviométrie. Les stations côtières enregistrent moins de 400 mm de pluies par an. Ces dernières années cette aridité est de plus en plus fréquente et intense ; elle se traduit par :

- Un retard des saisons de pluies d'où prolongement de la saison sèche
- Une nappe phréatique insuffisante à cause d'un déficit de l'écoulement pendant la saison pluvieuse
- Une humidité du sol insuffisante qui ne garantit pas la croissance des cultures.
- L'avancée des dunes et l'ensablement de l'arrière pays accentuant ainsi la désertification.

Les scénarios sur le changement climatique pour l'ensemble du pays prévoient vers l'horizon 2100, une diminution des précipitations saisonnières qui seraient comprises entre – 5% et -10% à Madagascar, le Sud Ouest de l'île est touché par cette variation négative. Ainsi, qu'une hausse de la température, de l'ordre de 0.5°C en 30 ans sur tout l'ensemble de l'île (*source: PANA Madagascar- Convention des Nations Unies sur les Changements climatiques*)

C. Les impacts et les interactions entre les écosystèmes

Les causes des perturbations de l'équilibre de l'écosystème sont fortement liées aux facteurs climatiques, même si ce type d'études est limité. Néanmoins, de nouveaux modes d'adaptation de la population aux aléas climatiques extrêmes sont observés et des actions environnementales sont entreprises.

1. Blanchissement des coraux

Le problème de l'élévation de la température de l'eau de mer associé aux changements climatiques risquent d'entraîner des dégradations majeures dont le blanchissement des coraux (S PROGES, 2006)

- L'ampleur du phénomène a été surtout enregistrée en 1998 et 2002 : nombreux sites du Sud Ouest ont connu un blanchiment des coraux, d'un site à un autre 15 à 25 % des coraux ont connu ce blanchiment .
- A titre d'exemple, pour le cas des récifs de la baie de St Augustin : des observations ont démontré que ce blanchissement des coraux a touché 3.78% des coraux en 2001 et 7,22% des coraux en 2002 soit une augmentation de 3, 44% des coraux blanchis.

Toutefois, le blanchissement des coraux n'est pas la première cause de la dégradation des récifs de cette zone, en effet les pressions anthropiques, l'hyper sédimentation en sont les causes principales**.**

2. Phénomène climatique extrême – adaptation de la population – pressions anthropiques – surexploitation des ressources

La réponse et l'adaptation de la population face à ces aléas climatiques et notamment l'accentuation de la sécheresse se traduisent de deux manières :

a. la terre non productive est délaissée, et comme alternative les agriculteurs se convertissent vers l'activité pêche : les méthodes de pêche de plus en plus agressives et destructives s'accentuent avec le nombre de pêcheurs qui exploitent des ressources de plus en plus appauvries. il a été estimé que chaque année 14 000 pêcheurs piétinent le platier récifal de cette zone. Au niveau du village des pêcheurs à Anakao, où les ressources sont plus abondantes qu'ailleurs ; le nombre de pêcheurs a presque doublé en l'espace de 10 années (1996 – 2006) . En effet, à part les migrants venant saisonniers ou définitifs qui s'installent au village, les quelques agriculteurs du village d'Anakao haut ont totalement abandonnés leurs terres agricoles.

b. La conversion des habitats écologiques en amont pour exploitation plus intensive des ressources forestières : en effet face à ces aléas climatiques de plus en plus extrêmes, les reliques de ressources forestières sont sur-exploitées pour assurer la survie des ménages appauvris. La déforestation pour la recherche de nouvelles terres plus aptes à la culture et le charbonnage à des fins commerciales. Pourtant, il faut savoir que cette ***déforestation est à l'origine de la destruction des écosystèmes en aval : les mangroves et les récifs qui sont exposés à des phénomènes d'envasement et de sédimentation très importants***. Le fleuve Onilahy se caractérisant par un fort taux d'érosion de 3 375 m3/km2/an (Thomassins, 1969) explique la pollution tellurique des récifs et se traduisant par la prolifération de la couverture algale du platier (Sargassum, Turbinaria…) et de la biodestruction oeuvrée par les étoiles de mer (*Acanthaster plancii*) et enfin l'étouffement des coraux.

Ces facteurs expliquent la dégradation de l'écosystème, illustrée par les faits suivants :

- Sur tout l'ensemble des écosystèmes récifaux de Toliara cette perte en abondance des espèces est de 40% (depuis les premières études en 1970 jusqu'à aujourd'hui 2006) (S PROGES).
- Raréfaction voire disparition de certaines espèces récifales : Lutjanidés, Heamulidés, Serranidés et de certaines espèces de coquillage surexploitées : tritons, casques, burgaux

- Ces dernières décennies, le taux annuel de défrichement de la forêt dans la région de Toliara est passé de 0.35% en 1962-1994 à 0.93% en 1995-1999 (Seddon et al., 2000), le taux de défrichement est estimé à 1.380 ha/an en moyenne et la superficie brûlée est de 16.300 ha/an en moyenne dans toute la région de Toliara.

D. Les réponses pour atténuer les changements climatiques dans le Sud – Ouest

Plusieurs réponses sont données pour ces changements climatiques. Pour la zone prise en considération des exemples seront donnés:

- Intensification des efforts de reboisement pour le captage de carbone et également pour la réduction des surfaces déboisées par an.
- Développement des sources d'énergie renouvelable, essentiellement l'énergie solaire, l'énergie verte (jatropha).
- Organisation et gestion durable de l'activité pêche dans la zone récifale
- Education des communautés concernant les enjeux du maintien de l'équilibre de l'écosystème.

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CLIMATE CHANGE IMPLICATIONS FOR THE IMPLEMENTATION OF CBD: A PLANT ECOLOGY PERSPECTIVE

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Keywords: Global Strategy for Plant Conservation (GSPC), ex situ conservation, 2010 indicators, Arctic Climate Impact Assessment (ACIA), plant biodiversity

ABSTRACT

During an advanced course in plant ecology, spring 2007, a class of thirteen students scrutinized the leading documents behind the Convention on Biological Diversity (CBD), including the Millennium Ecosystem Assessment (MA), the third and fourth Intergovernmental Panel on Climate Change (IPCC) assessment reports (2001 and 2007, respectively), Arctic Climate Impact Assessment (ACIA), the World Wildlife Fund (WWF)'s "Living Planet", and the Global Strategy for Plant Conservation (GSPC). Besides of the latter, the conclusion was that plants were relatively well accommodated in IPCC's 2001 and 2007 reports and in ACIA, but less so in MA and Living Planet. A general consensus across all reports is that biodiversity of cold regions (polar and mountains) is under particular threat from Climate Change. As much as 60 % of alpine ecosystems may disappear by 2100.

The optimal strategy for plant diversity conservation is protection of large areas spanning over climate zones, allowing plants to migrate with shifting climate zones. This must be the primary action for conserving biodiversity because it protects entire ecosystems, and not just individual species. *Ex situ* conservation in the form of seed banks and botanic gardens can function as insurance against genetic loss in natural populations, but not as a conservation strategy, as genetic and ecosystem diversity cannot be effectively conserved in this way. Furthermore, cold climates are particularly difficult to simulate in a greenhouse environment. Whereas a tropical rainforest climate is relatively simple to maintain in greenhouses and work well for public display in many botanic gardens, mountain tundra is notoriously problematic. Simulating a harsh winter season *ex situ* is logistically difficult, and not particularly attractive as to public display.

Protecting 10% of all habitats is a problematic strategy because 10% of a well-preserved habitat may be sufficient while 10% of a heavily fragmented habitat would not be enough to sustain its present biodiversity. A 10% limit is also problematic as research indicates that the minimum of a preserved habitat for successful conservation is 20% of the original habitat size. This does not necessarily mean nature reserves, but merely limitations and adaptations in land use of sensitive areas.

The Subsidiary Body on Scientific, Technical and Technological Advice (SBSSTA) of the CBD has evaluated a series of indicators - the 2010 biodiversity indicators - for the implementation of CBD. These include the extent of selected biomes, ecosystems, and habitats, and trends in the abundance and distribution of species. Species abundance will be measured by different indices such as LPI, RLI and STI. However, the focus in these indices seems to be on the groups with the most data collected, leading to strong bias towards vertebrates, especially birds. This causes problems since larger vertebrates are usually generalists and therefore more specialized organisms can be lost without notice. Since plants in general and cryptogams in particular are more sensitive to changes in the environment than animals, they should be more useful as indicators of loss in biodiversity. Attempts should be made to create indices that pay more attention to plants. To do so would require more resources devoted to research and education regarding plant ecosystems, especially in tropical

and other areas of the developing world. If the implementation of CBD shall be successful, issues concerning the biodiversity of plants should be given more attention. The reference baseline for comparison of indices has been suggested to be the pre-industrial situation. We recommend a more modern baseline when sufficient biodiversity data have had accumulated.

According to GSPC, communication, education, and the raising of public awareness, about the importance of plant diversity are crucial for the achievement of all the strategies' targets. Most of the parties have indicated active national programmes linked to this. However these activities are often undertaken by non-governmental organizations. The importance of governmental involvement in public education is crucial for awareness at all levels of the society.

Terrestrial ecosystems are based on plants, yet very little attention has been given to plants in the past. This is a problem, since any loss of plant biodiversity will necessarily lead to the loss of other organisms. Therefore it is fundamental to focus conservation efforts on preserving plant ecosystems and biodiversity.

THE MOST THREATENED TERRESTRIAL ECOSYSTEMS ON EARTH — AND THE LEAST

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Keywords: climate change, snowbeds, cliffs, plants, endemism

ABSTRACT

Mountain landscapes host both the most and the least threatened ecosystems on Earth. This situation has arisen as a consequence of changes in climate and/or land use, and the combination of these two components of Global Change may lead to drastic changes within the next few decades. This change in landscape ecology is already ongoing at high speed in many mountain areas across the planet as well as in the polar region, as pointed out already in the Intergovernmental Panel on Climate Change (IPCC)'s Third Assessment Report (2001) and stressed even more in the Arctic Climate Impact Assessment (ACIA, 2004) and in IPCC's Fourth assessment report (AR4, 2007).

Snowbeds are conspicuous components of most alpine tundra areas of the World. They are known to host unique ecosystems with plants and animals adapted to a very short growing season. At the same token, snowbed provide important ecosystem services to the landscape, such as providing neighboring ecosystems with a steady water supply throughout the summer and being instrumental for the maintenance of sustainable populations of small mammals and certain bird species (Björk & Molau 2007). In the Scandinavian mountains, snowbeds are important for a sustainable reindeer husbandry by providing lush grazing areas in late summer and by being used for cooling and mosquito release at peak summer (traditional Saami ecological knowledge).

The poster illustrates snowbeds and snowbed plants from two contrasting areas, viz. the Abisko area in northern Swedish Lapland and the Bogong High Plains in southeast Australia. Snowbed specialist plant species in Scandinavia are still not under particular threat of final extinction as they often have wide geographical distributions, some of them even being circumpolar. However, the entire ecosystem is shrinking rapidly in total area (10-20% loss since 1990). In isolated mountain areas in central Sweden and Norway, snowbed communities that are well documented from the 1930ies do not exist any more in these massifs.

In Australia the total area of tundra above the treeline encompasses only a few hundred square kilometers. Of this area, about 10 % is presently still occupied by snowbed ecosystems, the prerequisites for which are vanishing rapidly. These snowbeds comprise a number of endemic vascular plant species that are under particular threat of going extinct, two examples are: *Caltha introloba* (Ranunculaceae) and *Celmisia sericophylla* (Asteraceae). Both species have a present total World population of a few thousand individuals at maximum, presumably less.

But mountain areas also house cliff ecosystems, often within visible distance from the snowbeds. Cliff ecosystems are probably the least sensitive habitats on Earth with respect to Climate Change. Their particular microclimate is generated primarily by capturing incoming solar radiation, and may be widely different from that of the surrounding "matrix" of a more level landscape. Cliffs are inhabited by a large number of highly ecophysiologically specialized plants and animals. Many of these species have large distribution areas, but their total populations are highly fragmented and consist of small local patches with small numbers of individuals. The persistence and genetical sustainability of such, permanently and naturally fragmented populations are of high interest to conservation biology in general. However, cliff ecology is a poorly explored research field,

even though cliff ecosystems add substantially to the overall biodiversity of a landscape or region. Many cliff species exist in small numbers without being particularly vulnerable at present since they inhabit "safe sites" in terms of climate change and human land use.

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CONSERVING WORLD HERITAGE BIODIVERSITY IN THE FACE OF CLIMATE CHANGE

Extracted from: "Case Studies on Climate Change and World Heritage"

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Keywords: World Heritage, Cape Floral Region Protected Areas, Great Barrier Reef, Ichkeul National Park

INTRODUCTION

There is a growing concern for conserving biodiversity at natural World Heritage Sites in the face of climate change. The UNESCO World Heritage Centre initiated an assessment of the impacts of climate change on World Heritage in 2005, after the World Heritage Committee noted that 'the impacts of climate change are affecting many and are likely to affect many more World Heritage properties, both natural and cultural in the years to come.' A meeting of experts was convened in March 2006 resulting in a 'Report on Predicting and Managing the Effects of Climate Change on World Heritage', as well as a 'Strategy to Assist States Parties to Implement Appropriate Management Responses.'

Although climate change is a global challenge, there are many adaptation and preventive measures that can be taken at the local scale, i.e. at the level of the World Heritage sites. Studies are currently being conducted at several World Heritage sites to monitor climate change impacts and plan appropriate adaptation measures. The World Heritage network is a useful tool to share and promote lessons learnt and best practices, as well as to raise awareness regarding climate change impacts using their iconic value.

Discussed below are three case study examples that are not meant to represent the whole range of issues but illustrate a few of the impacts that climate change can have on World Heritage properties, as well as possible adaptation measures.

CASE STUDIES

Cape Floral Region Protected Areas (South Africa)

The Cape Floral Region represents less than 0.5% of the area of Africa but it is home to nearly 20% of the continent's floral biodiversity. As such it has been identified as one of the world's 18 biodiversity hot spots, and is recognized as one of the world's six floral kingdoms.

The most threatening aspects of climate change for the conservation of this area include shrinking of optimal bioclimatic habitats with warming and potential drying (see Figure 1), ecosystem changes in response to modification of environmental conditions, and increase of fire frequency (WHC06-30COM7.1). In addition, there exists a threat of invasive alien flora which are less sensitive to climate change than indigenous species (Richardson, 2000). Also, some coastal lowlands are threatened by sea-level rise in the area, which will further reduce the remaining natural buffer between the ocean and human developments at the expense of coastal species and ecosystems. Lastly, projected changes in soil moisture and winter rainfall will modify species distributions.

A monitoring system is already in place to detect the possible effects of climate change; it includes survey of species present in the region, but could be expanded to screen other potentially invasive alien species to prevent future invasions (IUCN, 2003). An improved network for the detection and prevention of wildfires would be most efficient in protecting this biome from the frequency and intensity of fires. Additional bio-climatic modelling could be used to test possible measures such as adapting the boundaries of the protected area to accompany the projected shift in species ranges. Finally, for species that are expected to face the most pronounced threats, translocation could be contemplated.

Great Barrier Reef (Australia)

The Great Barrier Reef is a marine site of remarkable beauty off the northeastern coast of Australia. It is the largest coral reef ecosystem in the world, 2,100 km in length, and covering an area of 344,400 km^2. The Great Barrier Reef Lagoon contains 2,900 individual reefs with 400 species of corals, 1,500 species of fish and several thousands species of molluscs.

The ecology of this site is sensitive to any change in the following climate parameters: sea-level rise, sea temperature increase (see Figure 2), ocean acidity, storm frequency and intensity, precipitation patterns, drought, land run-off, etc. One of the most dramatic and serious effects of climate change is the physiological consequences of coral bleaching, which has already caused long-term damage to many coral reefs worldwide.

A Climate Change Response Programme (2004-2008) has been developed to better understand and respond to the threats of climate change to the Great Barrier Reef. One key output of the programme includes the Coral Bleaching Response Plan, which aims at detecting and measuring bleaching and other short- and long-term impacts; it has received worldwide recognition. Also, a key output is the Climate Change Action Plan, which aims at sustaining ecosystems, industries, and communities by identifying and implementing relevant management actions, adapting policy and fostering collaborations. (Marshal, 2006)

Ichkeul National Park (Tunisia)

The Ichkeul Lake and marsh constitute a remarkable wetland system in northern Africa. It is a major stopover point for hundreds of thousands of migrating birds, such as pochards, wigeons, coots, and greylag geese which come to feed and nest there.

In 1996 this site was inscribed on the List of World Heritage in Danger, due to the construction of three dams on the rivers supplying Lake Ichkeul and its marshes which lead to long periods of drought, decreased freshwater inflow, and increased saltwater inflow. In addition, a slight decrease of precipitation has been observed since the 1930s. As a consequence, there has been an increase in the salinity of the lake, drying of the marshes, and decrease in freshwater plants, leading to a sharp reduction in the migratory bird populations.

Climate models consistently project an increase of atmospheric temperature, up to 2°C to 4°C in northern Africa during the twenty-first century, and a possible 0.88m sea level rise. The projected precipitation trends show a slight decrease, but most importantly an increased spatial and temporal variability. These changes will probably affect the functioning of the catchments and thus increase the existing pressure on the park. (Kraiem, 2002)

Adaptations measures and monitoring programmes have been developed to face these impacts and water supply planning now accounts for the consumption of freshwater by the Ichkeul Lake and marsh. Freshwater inflow from the dams upstream is regulated as well as exchanges of salted water with the sea downstream. Because of growing resilience of this biome, the site was removed from the List of World Heritage in Danger in July 2006 (see Figure 3). But if the projected trends of climate change are confirmed during the twenty-first century, the area is likely to face conditions similar to, or worse than, those of the 1990s.

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FIGURE 1. Shifting and shrinking ranges of the Protea lacticolor flower in Cape Floral Region Protected Areas (South Africa). The areas where this iconic plant will persist are displayed in green, while in many areas it will become extinct (red). (Hannah, 2005).

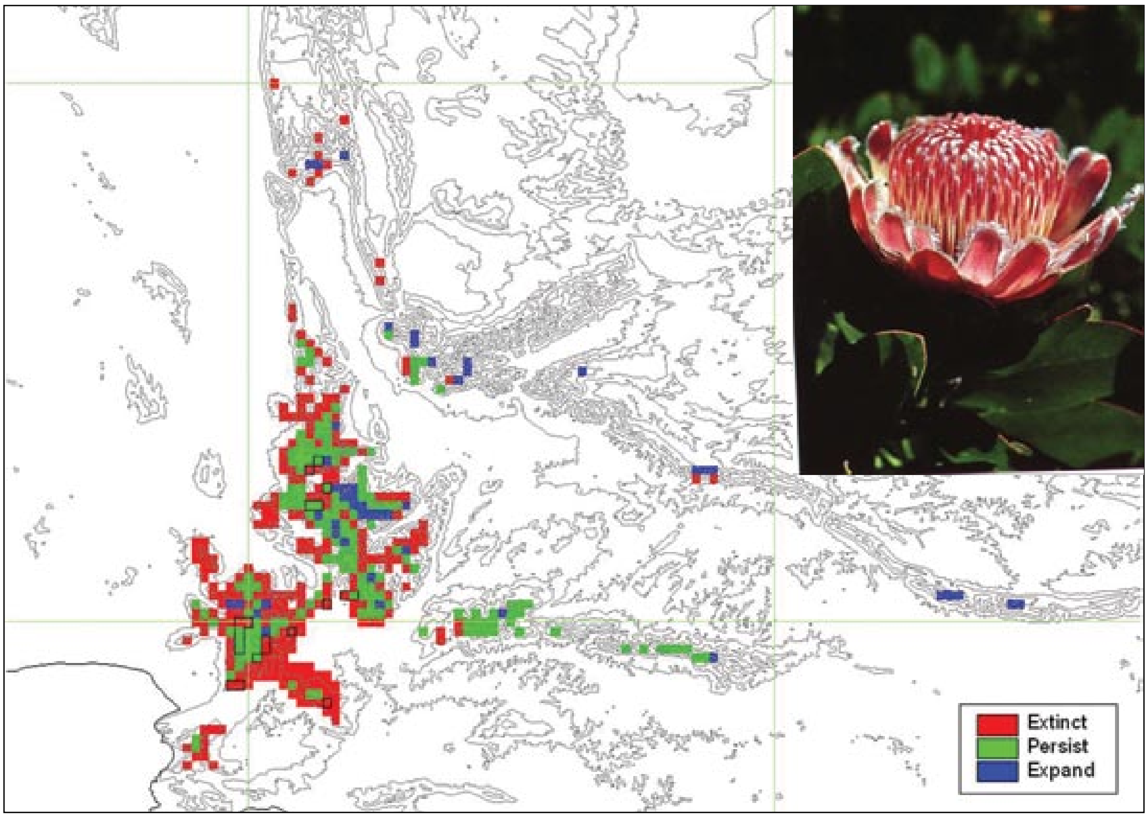


FIGURE 2. Sea surface temperature trends in the Great Barrier Reef region generated by the global coupled atmosphere-ocean-ice model (ECHAM4/ OPYC3) forced by greenhouse warming that conforms to the IPCC scenario IS92a. Horizontal lines indicate the thermal thresholds of corals at each site. (Hoegh-Guldberg, 1999)

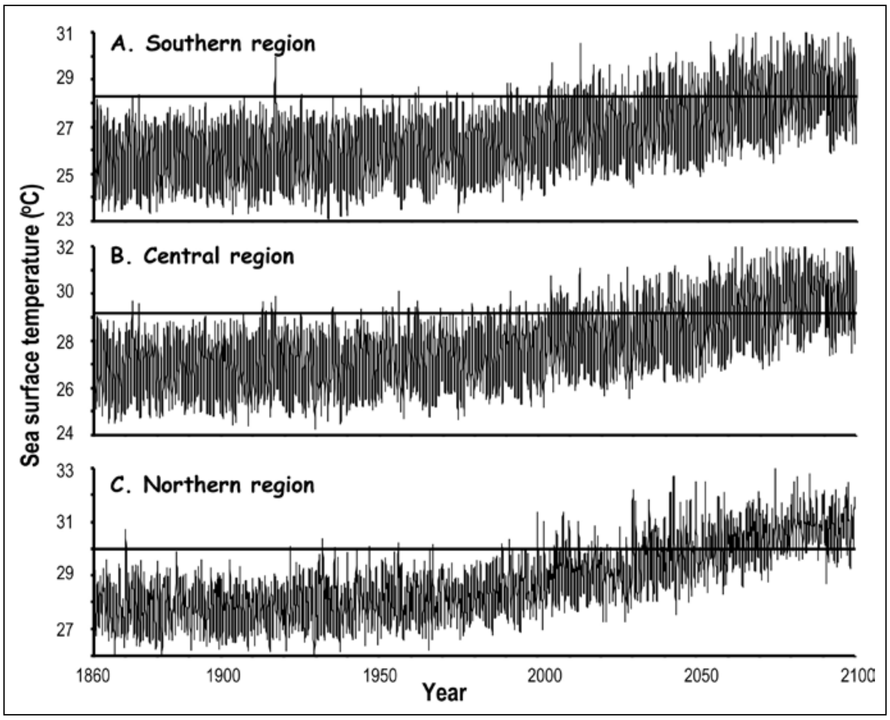
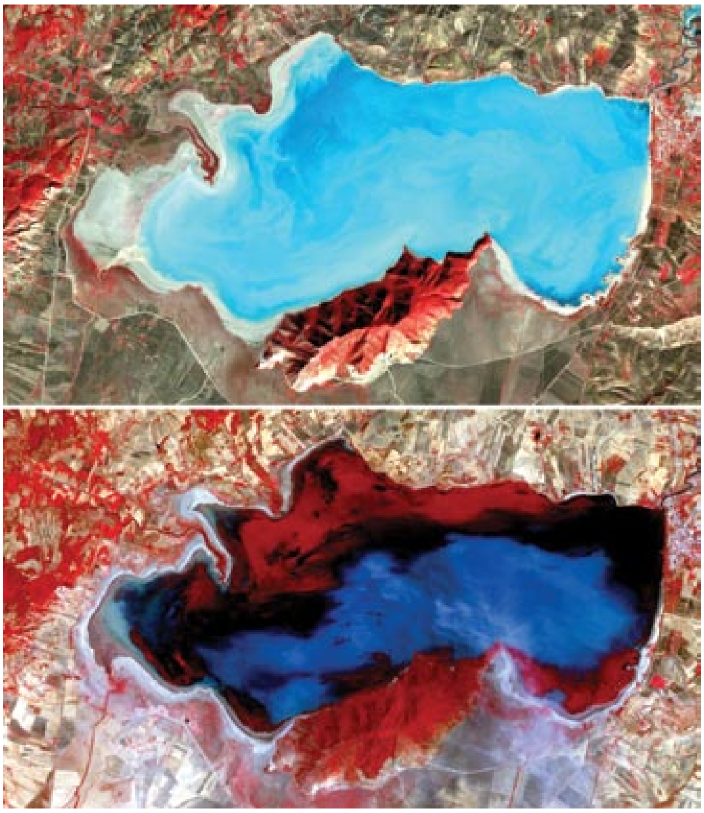


FIGURE 3. Composite images of the ASTER satellite showing the vegetation in shades of red. The photograph of the Ichkeul Lake and marsh taken in 2001 (at the top) shows that potamogeton pectinatus have disappeared from the lake. In 2005 (at the bottom), after a tailored adaptation plan was implemented and climatic conditions improved, the vegetation recovered in the lake. (NASA/GSFC/METI/ERSDAC/JAROS, and U.S./Japan ASTER Science Team)



ENVIRONMENTAL RISK ASSESSMENT FOR BIODIVERSITY AND ECOSYSTEMS: RESULTS AND PERSPECTIVES OF THE LARGE SCALE INTER- AND TRANSDISCIPLINARY RESEARCH OF THE ALARM PROJECT

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Key words: risk assessment, biodiversity, ecosystem, climate change

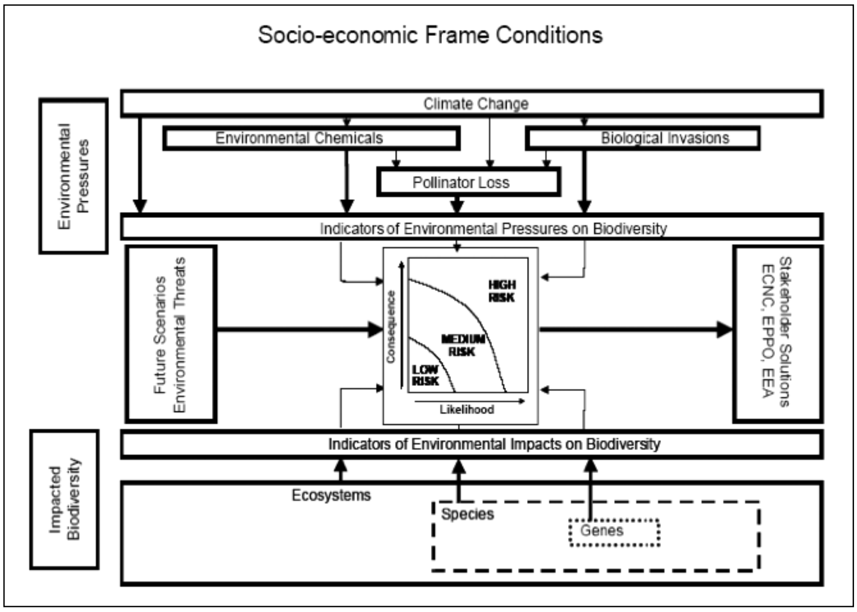
ABSTRACT

The general ALARM (Assessing LArge-scale environmental Risks for biodiversity with tested Methods) objectives are a) To develop an integrated large scale risk assessment to biodiversity as well as terrestrial and freshwater ecosystems as a part of environmental risk assessment, b) To focus on risks consequent on climate change, environmental chemicals, rates and extent of loss of pollinators and biological invasions; c) To develop and maintain a research network that is constantly interacting and investigating on a continental scale across different environmental problems (impacts) and across different spatial and temporal scales of ecosystem diversity changes; d) To establish socio-economic risk indicators related to the drivers of biodiversity pressures as a tool to support long-term policies and to monitor their implementation, and e) To provide a contribution to objective based politics, to policy integration and to derive outcome-oriented policy measures by contributing to the integrated assessment of socio-economic drivers affecting biodiversity and integrated, long-term oriented means to mitigate them.

The main pressures analysed within ALARM (climate, chemicals, invasions, pollinator loss) are massively introduced into the environment as a function of human activities. They have been generally studied independently of each other. Yet it is clear on a large scale, that they can and will interact, potentially producing effects on ecosystem diversity that exceed all current assessments of potential risk. There are currently no methods that allow continuous integration across these pressures, especially as new information and understanding is developed (within each sector) and new concerns arise about sustainability. In addition there are no methods that cross-connect the pressures with sentinel indicators of changes in biodiversity. ALARM attempts to develop these methods, which will be tested and protocols developed for the assessment of environmental risks.

To quantify the impacts of environmental pressures, ALARM will use combined risk likelihood and risk consequences scores (see Figure 1). Scenarios are applied to simulate future environmental threats and to quantify risks subsequent on these. Results of these approaches will lead to a Risk Assessment Toolkit (RAT) which will be communicated to stakeholders for broader application.

FIGURE 1: ALARM scheme for Integrated Risk Assessment for different levels of biodiversity. Socio-economic pressures and indicators form the general background.



2
USE OF BIODIVERSITY IN ADAPTATION MEASURES

WHO SHOULD DECIDE ABOUT THE DEMAND OF AGRO-BIODIVERSITY?

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Keywords: participation, subsidiarity principle, institutional change, environmental goods, region

INTRODUCTION

The Common Agriculture Policy (CAP) comprises a wide field of different policies and its complexity increases with time. Since the reforms of the European agriculture politics in 1992, a new level of complexity has been reached; in particular with the implementation of the rural development policy - the second pillar of the CAP (Council regulation EC No. 1698/2005 (EAFRD)). The integration strategy in this regulation sets specific objectives including climate change reduction, landscape and biodiversity presservation. The European Union (EU), as well as the member states, is oriented into sectoral policies and, additionally, there is a vertical and horizontal political inter-dependence in the second pillar. Consequently, the regions select projects depending on the best co-financing by the EU and they often fail to address regional requirements as well as the subsidiarity principle (cp. Bauer 2006; Henning 2005). Furthermore, there are many stakeholders who participate in and who influence policy making and its implementation. These stakeholders are also differentiated by levels. Thus, the problem is that there are many different political and organisational levels which are each involved in rural development policy and its implementation. Such circumstances make the complex system non-transparent and this contributes to the avoidance of an adequate implementation in accordance with the European principle of 'subsidiarity'. This abstract focuses on agri-environmental schemes as one part of the thematic axis "environment and countryside" of the second pillar and it deals with the question of which policy level should decide about the demand of environmental goods and services as agro-biodiversity or greenhouse gas mitigation. Firstly, we define the concept of a region and why we prefer the regional level. Then we explain the prospects and advantages of this decentralisation and we constitute challenges. Completing we outline a German case study of a regional and participatory agri-environmental scheme and give an outlook about our future research topics.

PROSPECTS BY REGIONS

Due to globalisation - with its social, economic and ecological complex interactions - the social reference of direct living space for identity and cooperation is on the regional level. A region should not only be defined by political boarders but it should also be defined flexible in accordance to issues. Concerning to programs for the improvement of agro-biodiversity, it should be an area with similar environmental potential. Furthermore, it ought to be a space where politics can be created and where political infrastructures are already established. The development potentials of a region are the individual strengths and weaknesses and the environmental factors - as well as the potential of resources and institutional dispositions (cp. Kockel 1987). The prospects of decentralisation of programs for the improvement of agro-biodiversity and the reduction of greenhouse gas emissions with respect to the subsidiarity principle, involve the use of regional 'know-how' and regional competences in consideration of efficiency (Bauer 2006). One advantage of decentralisation is that all relevant actors with regional 'know-how' and competences are already available. Regional actors should be involved in environmental policies and its implementation within a participatory process (Hespelt 2004, Eggers 2005) because participation implies an advanced acceptability and legitimisation by the population as well as certain organisations, for example, nature conservation stakeholders (Hespelt 2004). Defining the ecological aims, especially for the improvement of agro-biodiversity on the regional level, it is feasible to adopt the agri-environmental programs to regional particularities and this leads, consequently, to a higher effectiveness of the programs because of a better specification. Against this background, we propose that the EU should only define general goals, and that on the regional level, these goals should be specialised considering the environmental particularities. The next level of a region can assist with a general consulting. The advantage of the EU defining general goals is that there are uniform guidelines and a superior organisation for monitoring purposes. According to the subsidiarity principle a learning process in regions needs to be organised. It is important to encourage participatory processes. The development process should be characterised by a balance between efficiency and liberty with respect to the flexible definition of a region, and this establishes a dynamic subsidiarity principle (cp. Hespelt 2004). It should be noted that there are some challenges to cope with, which are explained in the following section.

CHALLENGES

Within the strengthening of the regional level special challenges have to be faced. These are the sectoral thinking (Bauer 2006, Hespelt 2004) and political inter-dependence, as well as the tendency towards structural perpetuation of familiar procedures (Eggers 2006). In addition, the expected higher transaction costs and the lack of rights of participation in the majority of the member states, as well as "pork-barrel" problems in rural development policies of the member states (see above) are often further challenges (Bauer 2006, Henning 2005). These challenges belong to the reasons why the administration often avoids innovative ideas for the regionalisation of environmental schemes (cp. Eggers 2005). In the demand for agro-biodiversity uniform environmental programs e.g. for the whole member state, or for the whole federal state, like it is in Germany, are often not useful (Bauer 2006) because regional natural potential remains widely unconsidered. Attention should also be paid to regional specific agri-environmental schemes regarding an efficient restriction of climate change.

CONCLUSION

To tackle these challenges we developed an effective payment scheme for the protection and the improvement of agro-biodiversity, as one example of an agri-environmental program, together with a local committee in a model region in the federal state of Lower Saxony (the rural district of Northeim) (Bertke et al. 2005). Four main points make this scheme different from actual programs: It is an (i) outcome-based and (ii) decentralised scheme according the European principle of subsidiarity. The payment scheme is (iii) market oriented in which a (iv) participatory regional board is responsible for the demand of regional-specific environmental goods of plant biodiversity - which are provided by the farmers voluntarily. These decisions of the regional advisory board are backed up by the local population in the case study region. Members of this regional advisory board are experts from the local Chamber of Agriculture and the Environmental Agency of the rural district of Northeim; members of the county council; and pressure groups such as the NGO institutions for Nature Conservation, the Farmers Union and the organisation of the landowners. Within this context, our future research will be concentrated on a regionalised administration structure that considers participatory bodies and the subsidiarity principle. We shall focus on the following three questions: (i) How could participatory agri-environmental schemes be implemented in the agri-environmental policy efficiently? (ii) How will regionalised administration function? (iii) What competencies, as well as financing structures, will the higher policy levels have to give up within the regionalisation of agri-environmental schemes?

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COPING WITH CLIMATE CHANGE THROUGH AGRICULTURAL DIVERSITY

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Key words: biodiversity, crop farming, in-situ conservation, climate change

CLIMATE CHANGE — A MENACE TO FOOD SECURITY IN THE TROPICS

The world's biological diversity is eroding. This concerns in particular the entire agricultural diversity of genes, species and their agrarian ecosystems. Agrobiodiversity is the resource base for food. With species becoming extinct, food security is jeopardised. Climate change increases this problem.

- The exposure of crops to increasing temperature will reduce species diversity and lower agricultural yields and, global warming will be highest in tropical and subtropical regions.
- Indirect temperature effects will increase soil evaporation, accelerate organic matter decomposition and aggravate pests and diseases.
- In the last century, subtropical regions were most likely confronted with around 3% less precipitation, whereas the northern hemisphere likely experienced 5-10% higher rainfall.
- As a summary conclusion to all these impacts, it is predicted that by 2080 the 40 poorest countries that are predominantly located in tropical Africa and Latin America may lose 10-20% of the grain growing capacity, whereas yield increases are expected in temperate regions.

ADAPTATION OF AGRICULTURE IS NEEDED

Dramatic implications are expected for global agriculture and food supply, but with enormous regional differences. Ironically, the poorest are most at risk. It is predicted that by 2080 the 40 poorest countries, located predominantly in tropical Africa and Latin America, may lose 10-20% of their basic grain growing capacity due to drought. It is also argued that many rain-fed crops in the tropical belt of Africa and Latin America are already near their maximum temperature tolerance, and their yield may fall sharply with a further rise. By contrast and for temperate regions, yield increases are expected due to higher temperatures, increased carbon dioxide levels and partly higher rainfall; a country like China could experience a rise in production by 25%.

As a consequence, adaptation to climate change that has become irreversible is required. This concerns agriculture in particular and agrobiodiversity is of key importance in this. Adaptation describes a plant's, animal's or ecosystem's capacity to adjust to changes such as heat, drought, or salinity — an adjustment enabling them to overcome constraints, take advantage of new opportunities and cope with the consequences of changing environments. The adaptation capacity of agricultural ecosystems relies fundamentally on genetic diversity. Plants with no economic value so far - may it be a drought resistant millet variety or a heat tolerant race of goats — may become important, and serve as genetic material for new breeds that can tolerate better environmental stress. The continuous loss of such species is a serious matter of concern.

AGROBIODIVERSITY — HOW MUCH SHALL BE CONSERVED?

As conservation is costly, the question arises: how much agrobiodiversity do we need? Scientists propose mathematic models by which priorities shall be set and the optimal degree of conservation shall be calculated. But, can we base public conservation strategies on mathematical modelling, or must we conserve all we have because the future needs for human survival are unknown?

It is often argued that conserving all — irrespective of any valuation — is unrealistic. But as a basic principle it can be formulated that a maximum of genetic resources has to be conserved at the lowest possible public cost. If this holds true, a conservation concept is required that goes far beyond the predominant approach of *ex-situ* conservation. Storage of seeds in refrigerated banks or botanical gardens is essential. But this method exceeds the capacity of public funding, is of limited scope and of limited security.

Such a more comprehensive approach relies primarily on *in-situ* concepts, managed by farmers and farming communities doing conservation and breeding on their farms and in their villages. Farmers have done so over thousands of years, have been ignored or neglected by the formal seed sector during the past 40 years and, since recently, are slowly being rehabilitated. On-farm conservation is not necessarily less costly, but the costs are mainly borne by farmers whereas the benefits are private and public.

Latest concepts of *in-situ* conservation follow the idea that conservation and use of genetic resources are closely linked. True to the slogan "use it or lose it", plant species or animal breeds should be used whenever possible, should contribute to securing rural livelihoods and to rural culture. As long as farmers themselves find it in their own best interest to grow genetically diverse crops, both farmers and society as a whole will benefit at no extra cost to anyone.

As a consequence, economic or social benefits have to be found for seemingly useless crops or farming systems and value has to be discovered in them. For instance, wild plants may be used for medicinal purposes, wheat landraces grown under organic agriculture may get a higher price, farming communities as a whole may profit from agro tourism if they maintain their diversity, etc. However, it will not be possible to find a market for everything that should be protected. Therefore, a remainder will have to be protected without "using" it - a service that has to be paid for by the public.

SPECIES ADAPTATION — BUT HOW?

Another argument that calls for a revised understanding of agrobiodiversity conservation is adaptation to climate change of single crops and animals, a process of selection and breeding. What matters within this process, is not so much the drought-resistant minor millet landrace, well stored in isolation and deep-frozen in a gene bank, but rather, exposure to the environment, on farmers' fields and considering the wide agro-ecological variations of sites. Resistance of plants to environmental stress (e.g. drought tolerance) is mostly a multi-genetic characteristic best developed by *in-situ* exposure to it. In contrast, it is difficult to achieve such traits through genetic engineering.

The social dimension is no less important. Adaptive capacity building has to address the poor and should enhance their human and social capital. The focus on women addresses the fact that in rural societies everywhere women have always been the seed keepers, the preservers of genetic resources.

Such a strategy as outlined above addresses regional and local agro-ecological variations. It offers site-specific solutions contrasting with those of the corporate sector, that follows the law of economy of scales and aims to distribute a standardised variety or a whole cropping system technology as widely as possible.

URGENT ACTION IS REQUIRED

There is little awareness among the various international development initiatives of the close relationship between climate change and food security and the role agrobiodiversity has to play. This concerns without distinction the programmes to fulfil the Millennium Development Goals (MDGs), the National Adaptation Programmes for Action (NAPAs) by the United Nations Framework Convention on Climate Change and others. Adaptation to climate change in agriculture - if discussed at all - deals mainly with improved water management (in view of more frequent drought and flooding events). Agrobiodiversity - although being a fundamental resource for adaptation - is almost forgotten.

Instead, it must become imperative to manage agrobiodiversity in a sustainable way and to use it systematically to cope with the coming environmental challenges. The following aspects deserve consideration:

- Stronger coordination is needed between main global programmes such as the United Nations Framework Convention on Climate Change, the Convention of Biodiversity and the International Treaty on Plant Genetic Resources for Food and Agriculture.
- Agrobiodiversity conservation is to be made a basic component of adaptation strategies to climate change.
- Programmes that manage agricultural genetic resources require re-orientation in their strategies. Formal institutional systems based on gene banks (*ex-situ* conservation) must be broadened to an integrated management system that includes the farmer based (in-situ) conservation.
- *In-situ* conservation of agricultural biodiversity must be made an integral part of agricultural development and be supplemented by *ex-situ* conservation.

Only the public sector can take the lead in implementing such a comprehensive approach, in which the private sector has an important supportive role. National and intergovernmental laws and regulations will have to provide the necessary legal frame, civil society organisations (CSOs) as well as the corporate sector are becoming increasingly important in filling this frame with development reality on the ground. So far, CSOs have taken the pioneering task of developing and spreading suitable concepts at the grassroots level. For instance:

- Worldwide, CSOs have catalysed a boom of farmer initiatives that practice organic agriculture based on maintaining biodiversity, avoiding the use of hybrid seeds and prohibiting transgenic crops.
- They are increasingly supporting local seed conservation initiatives, such as Navdanya in India, that aims to "empower local communities (...) to protect and conserve their biodiversity and defend their community rights to seeds and knowledge".
- They have founded an alternative market for plant breeding and seed production. Mainly in Europe, various initiatives have emerged that maintain, improve and make available open pollinating varieties of cereals and vegetables, many of which are the result of crossbreeding and selection over centuries and in danger of getting lost. Kultursaat e.V., an association in Germany that releases new varieties as public property, is a prominent example.

All such activities make it very clear: Genetic resources must remain largely in the public domain; with well-balanced benefit sharing concepts among the stakeholders that use and conserve agro-genetic resources. Generally, the in-situ approach offers a great chance to shape a future worth living.

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TRANSFORMATION OF BIODIVERSITY AND CLIMATE-RELATED AGRICULTURAL POLICY: CHALLENGES AND PROSPECTS OF ADOPTING EUROPEAN SCHEMES IN AN INTERNATIONAL CONTEXT

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Keywords: biodiversity, agro-environmental schemes, policy transfer, policy adaptation

INTRODUCTION: BIODIVERSITY AND CLIMATE-RELATED AGRICULTURAL POLICY IN AN INTERNATIONAL CONTEXT

As agriculture occupies 38% of the worlds land area, its impact on biodiversity and greenhouse gas emission is considerable. In order to mitigate negative impacts, European countries, the USA, Australia and other developed countries have established diverse economic instruments, alongside mandatory regulations and advisory measures. We focus here on biodiversity and climate-related economic schemes. Although these schemes vary markedly between countries, they mostly share the same core concept, meaning that farmers are paid to modify their cultivation or livestock husbandry in order to support biodiversity or mitigate climate change. In recent years, innovative agro-environmental schemes, in Switzerland and in the German federal states of Lower-Saxony and Baden-Württemberg, are implementing outcome-based approaches (versus the earlier actions-based approaches), as well as public participation in design and operation (Gerowitt at al., 2003).

In developing countries, much of the biodiversity conservation and climate change mitigation efforts have thus far been focused on wildlife conservation or on reducing the conversion of forests into agricultural lands (PES, 2007). Less effort is directed at improving the environmental management of lands that are already in agricultural use. To meet the increased demand for food, agricultural production will intensify all over the world. Within this process, the multifunctionality of agriculture, including its biodiversity and climate impacts, should be tackled. Although the effectiveness of the European agri-environmental schemes is not univocal (Kleijn et al., 2006), they do set a benchmark, and the implementation of their principles in other countries may be beneficial.

Many challenges arise when attempting to assimilate the policies developed for one country in another, causing this to be a transformation, rather than simply a transfer. The adoption of European agri-environmental schemes in an international context is explored here, with Israel serving as a case study. Israel's relevance results from its relative-developed economic status, which make the use of economic environmental incentives feasible. However, Israel varies from many industrialized countries considerably in public awareness to biodiversity and climate change, and the absence of agri-environmental schemes. Israel also shares some characteristics with developing countries, such as a high rate of population growth (2% annually) and the emergence of "mega-cities", as 92% of its population resides in urban areas (in comparison with 50% of the population in the EU). Drawing from an ongoing effort to establish biodiversity and climate-related agricultural schemes in Israel, the challenges listed below were detected.

CHALLENGES OF TRANSFERRING BIODIVERSITY AND CLIMATE-RELATED AGRICULTURAL POLICIES

The local and regional environmental services of agriculture

Biodiversity and climate-related agricultural schemes should be tailored to meet the specific characteristics of the local ecosystem. For example, in Northern Europe, many agri-biodiversity schemes emphasize production extensification; however, in Mediterranean areas, traditional agricultural practice is believed to have positive impacts on biodiversity, as many species depend on agriculture-created habitats (Preiss et al., 1997). The abandonment of agriculture, which is widespread in Israel, as well as in many other Mediterranean countries, may be the major challenge that agri-environmental schemes would need to tackle in this geographic context.

Biodiversity conservation and climate-change mitigation in an urban and peri-urban context

European agri-environmental schemes are usually implemented in rural areas. However, in many other countries, biodiversity and climate-related agricultural policy would increasingly be practiced in the urban and peri-urban context. Urbanization presents unique challenges and opportunities. On the one hand, farmers may find it tempting to relinquish agricultural and landscape-conservation practices in favor of an easier and better-paid urban job; on the other hand, city dwellers may comprise a major source of financial support for conservation. In Israel, public preference surveys continually identify a steady demand and a willingness to pay for agricultural landscapes, which may be mobilized for the benefit of biodiversity conservation and climate-change mitigation through agriculture.

The institutional framework for biodiversity conservation

European agro-environmental schemes are payment-based, and are grounded in a long tradition of agricultural subsidies (Bräuer et al., 2006). But what about countries where subsidies for farmers do not exist? In Israel, income payments to farmers are limited in scope and variable; the majority of financial support for agriculture is provided in the form of subsidies for irrigation water and partial coverage of investments in farms by the government. Both are unsustainable policies, as they encourage wasteful use of scarce resources and production intensification. Should a system of income payments to farmers be established for environmental purposes alone? It may be more feasible to adjust the existing support system to meet biodiversity and climate change goals. For example, the public support for agricultural investments may be used to encourage the establishment of agri-habitats, e.g. planting of olive groves that contain valuable biodiversity (Loumou and Giourga, 2002).

Participatory approach in the design of agri-environmental schemes

Public participation in the design of environmental policy was promoted by Agenda 21, by the Convention on Biological Diversity and, more recently, in EC Council Regulation No. 1698/2005 and in the water framework directive 2000/60/EC. Although the idea is not new, its implementation is still limited to the more innovative European agri-environmental schemes. Are such participatory approaches feasible in other political cultures, including less discursive ones? Is the cooperation of farmers and nature-conservationists possible in the absence of a prior, reciprocal process, as was experienced in Europe in the past decades? In Israel, where public discussion on agri-environmental issues is rather recent, farmers and conservationists' participatory frameworks have at times radicalized conflicts rather than mitigated them. A more productive approach may be to conduct discussions among the farming and the nature-conservation publics separately, at least during the first steps of development of agri-environmental schemes.

PROSPECTS OF ADAPTING BIODIVERSITY AND CLIMATE-REALTED AGRICULTURAL POLICIES WORLDWIDE

Despite a lively public discussion regarding agriculture-environment relations, agri-environmental policies have not yet been implemented in Israel. Based on this case study, it may be argued that those who wish to introduce such instruments into a new geographic context may benefit from taking into account the local ecosystem's characteristics, land use patterns, institutional framework and public attitude, as cornerstones of biodiversity and climate-related agricultural policy transformation.

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EXPLORATORIES FOR LARGE-SCALE AND LONG-TERM FUNCTIONAL BIODIVERSITY RESEARCH

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Keywords: ecosystem functioning, experiments, land use, research platform

INTRODUCTION

The European society ultimately depends on sustainable ecosystem services. A major research challenge in this context is the role of biodiversity for these ecosystem services. It is clear that global land use and land use changes critically affect biodiversity. However, it is poorly understood how changes in biodiversity feed back on ecosystem services. Such an understanding is urgently needed to advice best-practice policy for sustainable land use. Climate change is expected to affect biodiversity either directly or indirectly via changes in type and intensity of land use. Thus, a comprehensive understanding of the functional consequences of biodiversity requires a joint consideration of climate and land use changes and must include the feed backs that changes in biodiversity have on decisions of land users and land management, and ultimately on society (Figure 1).

Funded by the German Science Foundation DFG we are establishing three exemplary large-scale and long-term research sites, the biodiversity exploratories. These exploratories combine the assessment of biodiversity of different plant, animal, fungal and microbial taxa with measurements of important ecosystem processes, and with experimental manipulations to unravel causal relationships between biodiversity and ecosystem functioning. Thus, they provide the scientific and intellectual infrastructure needed for successful projects addressing effects of changing biodiversity on ecosystem processes in real landscapes. The three exploratories are distributed across Germany (Figure 2) to cover a wide range of climatic and landscape settings in which the relationships between climate change, land use intensity, biodiversity change, and ecosystem functioning in forests and grasslands are being investigated. The main objectives of this project are:

- To assess biodiversity-ecosystem functioning relationships
- To understand the relationship between biodiversity of different taxa and levels
- To understand the role of land use and management for biodiversity
- To understand the role of biodiversity for ecosystem processes

METHODS

In an integrative approach with standardized methodology the exploratories merge biodiversity and ecosystem research, environmental science and socio-economic approaches in a common hierarchical design. Each exploratory comprises a large number of study plots differing in their intensity of investigation. In the first phase the project considers grasslands and forests. A grid of 1000 study points per exploratory covers the chosen landscapes. At this scale, the number and abundance of vascular plant species, as well as land use types and intensity will be recorded. In addition, a soil sample from each grid point will be analysed. Various monitoring methods will be used to assess the diversity of birds, bats, and other mammals.

After this first assessment, one hundred plots per exploratory are selected for more intensive studies in forests and grasslands to represent broad gradients of land use intensity from near-natural, protected sites to intensively used ecosystems. These intensively studied plots will contain instrumentation to measure soil and air temperature and soil humidity. On these plots, the diversity of further taxa will be assessed, including Hymenoptera, Heteroptera, Diptera, and selected Coleoptera. Moreover, the pollinator webs for grassland plants and forest under storey plants will be quantified by repeatedly collecting pollinating insects on individual plants. For the intensively studied plots, we will assess associated ecosystem processes, such as standing biomass and growth in forests, annual net primary productivity in grasslands, soil respiration, and carbon and nitrogen pools in different parts of plants. On a further subset of 16 very intensively studied plots, the microbial community and the diversity of mycorrhizal fungi will be assessed with molecular markers.

On the intensively studied plots, a control plot will be monitored and a number of experimental manipulations will be performed. They involve manipulation of plant diversity, exclusion of functional groups or shift of resources to study the consequences on diversity and ecosystem functioning for a given land-use type and land-use intensity. These experiments will address causal relationships beyond the correlative evidence gained by observations and monitoring. They involve sowing experiments to overcome seed limitation, the exclusion of large herbivores to assess their influence on tree recruitment and tree diversity, litter translocation experiment to test for changes in soil carbon and decomposer community, dead wood manipulation experiment to assess their importance for the xylobiontic community, small vertebrate exclusion experiments to assess their importance for arthropod diversity seed set of plants, predator-prey manipulations, herbivory experiments to quantify the degree of herbivory on individual plants, and others.

CONTRIBUTING PROJECTS

As of 2008, further contributing projects funded by the DFG will be integrated into the exploratories and assess hitherto non-studied taxa and ecosystem processes and carry out additional experimental investigations. These contributing projects will further broaden the scope of the exploratories by introducing additional aspects, for instance genetic diversity of selected taxa and landscape ecological approaches. Additional experiments will be executed to test the relative importance of various drivers of diversity, most importantly on the interplay between climate change and land use changes. Socio-economic evaluation and modelling of management strategies will integrate decisions made by land users and by society. In addition, by adhering to the same three exploratories and to a common statistical design, all these projects will allow us to directly compare the data collected by different groups of scientists and thus integrating biodiversity, ecosystem, environmental and socio-economical research into a general, interdisciplinary framework.

CONCLUSIONS

The biodiversity exploratories represent a long-needed research platform for all scientists studying biodiversity and its consequences for ecosystem functioning and ecosystem services. By combining monitoring of biodiversity and ecosystem measurements with experimental approaches, the exploratories will overcome the separation of disciplines that hindered a comprehensive understanding of biodiversity in the past. Both the spatial scale with sites across Germany and the project's designated duration of more than 10 years assure that the results cover relevant gradients of land use and climate change in a real landscape and encompass time-scales on which ecological processes typically occur.

Further information

www.biodiversity-exploratories.de

FIGURE 1. Graphical illustration of the concept underlying the biodiversity exploratories. Societal forces affect the type and intensity of land use, influencing biodiversity at several levels of biological organization, which in turn affects the services provided by ecosystems. Indicated are various feed backs of the functioning of ecosystems on biodiversity, and on the decisions by land users and society.

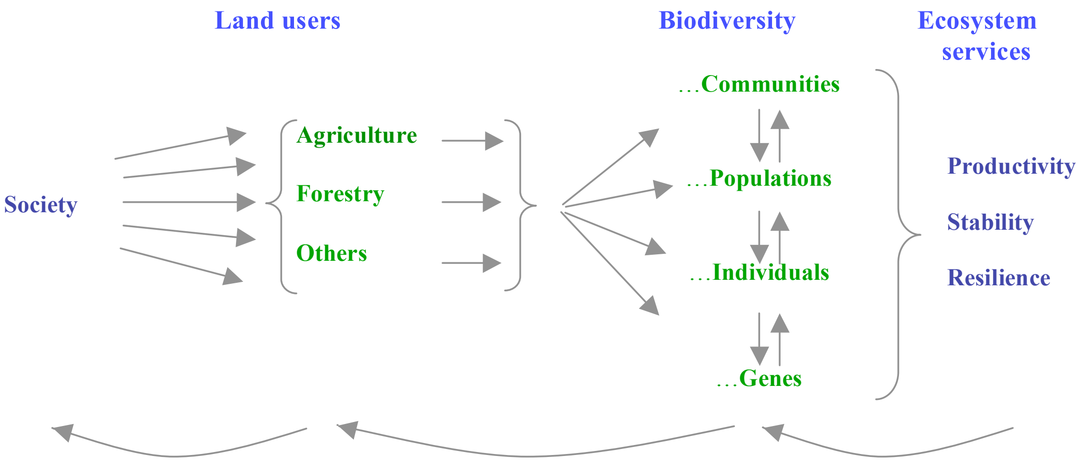
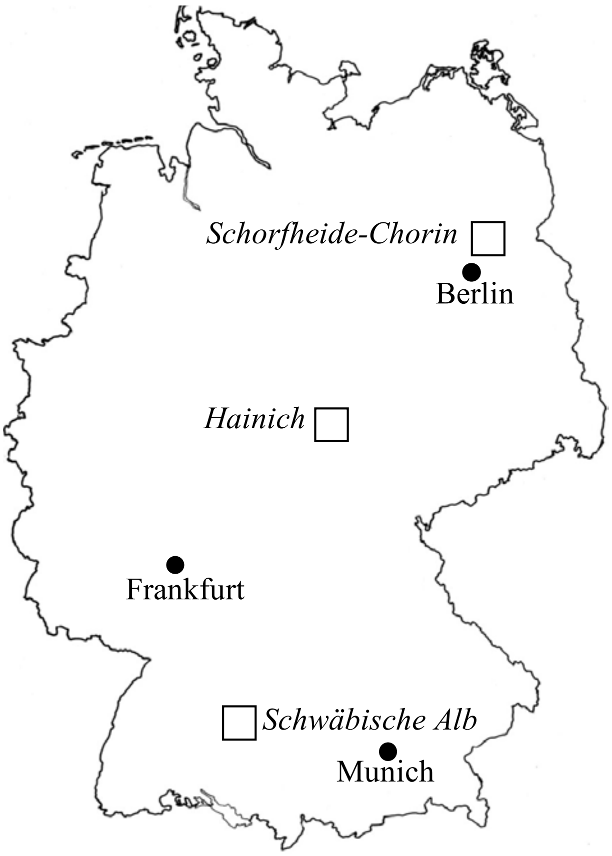


FIGURE 2. Location of the three biodiversity exploratories "*Schorfheide-Chorin*", "*Hainich*", and "*Schwäbische Alb*" in Germany.



TOWARDS A PROJECT LOOKING AT THE EFFECTS OF CLIMATE CHANGE ON QUEBEC BIODIVERSITY AT OURANOS

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Keywords: Regional climate change, climate vulnerability, impact and adaptation, biodiversity

EXTENDED ABSTRACT

The mid point of projected global warming at the end of this century is approximately 3.5° C (IPCC 2007). Thus, the speed and amplitude of expected climate change during the 21st century will be highly significant when compared to Holocene changes. A simplistic linear extrapolation based on Holocene migration patterns in North America suggests that we may see the ranges of species move by several hundreds of kilometres during this century. While some species may be able to track climate that quickly, many others are unlikely to do so. Water ecosystems may also be very much affected (Natural Resources Canada, 2007). The implications for biodiversity conservation are significant. Since most protected areas are on the order of a few tens of kilometres wide on a side, movements of hundreds of kilometres have the potential to completely reshuffle the flora and fauna contained within them. Species unable to adapt or move will be trapped, increasing local extinction rates. In Canada and in particular in the province of Québec, biodiversity is structured by a strong climatic gradient. Lemieux and Scott (2005) estimated that 37–48 % of Canada's protected areas could experience a change in terrestrial biome type. Within this context, it is essential to reinforce knowledge anticipating biotic responses to climate change to design adequate regional conservation strategies.

Here we aim to communicate how climate change science developed at Ouranos is being used to develop adaptation strategies by presenting a new initiative concerning biodiversity and climate change. Ouranos, a Canadian consortium on regional climatology and adaptation to climate change, was launched in 2002 by 8 provincial ministries of the Government of Québec, Hydro-Quebec, and the Meteorological Service of Canada. With this initiative, Québec decision makers confirmed that Vulnerability and Impacts assessments and the development of Adaptation strategies (V&I&A) in the context of climate change were a priority. Ouranos aims to support an integrated scientific program, to develop a structure for analysis of multidisciplinary problems, and promote synergetic work in the search for solutions to climate change adaptation issues in a North American context. Ouranos has improved or modified several tools to support V&I&A assessment and analysis including the Canadian Regional Climate Model and climate change scenarios applied for priority issues (Figure 1 and Ouranos, 2007). By working at a regional scale and enabling links between various researchers and decision makers, Ouranos provides an opportunity for innovative multidisciplinary, multi-organisational dialogue and facilitates mainstreaming of adaptations.

The objective of the new Ouranos initiative on biodiversity is to predict potential effects of climate change on the distribution and abundance of a large range of plant and animal species in Quebec. If accepted by co-funding agencies, the project will support regional strategies of adaptation to climate change in the field of biodiversity conservation. The objectives of the project are : (1) to describe the relationships between recent (30-40 years) changes in climate and changes in the phenology and distribution of target animal and plant species from Quebec; (2) to forecast, using ecological niche models, future (2050 and 2100) changes in distribution and abundance of a large range of species in relation to scenarios of regional climate change; (3) to elaborate regional adaptation strategies for biodiversity conservation, in close collaboration with partners

(Parks Canada Agency, Canadian Wildlife Service, Ministère du Développement Durable, de l'Environnement et des Parcs du Québec, Ducks Unlimited Canada, and Nature Conservancy).

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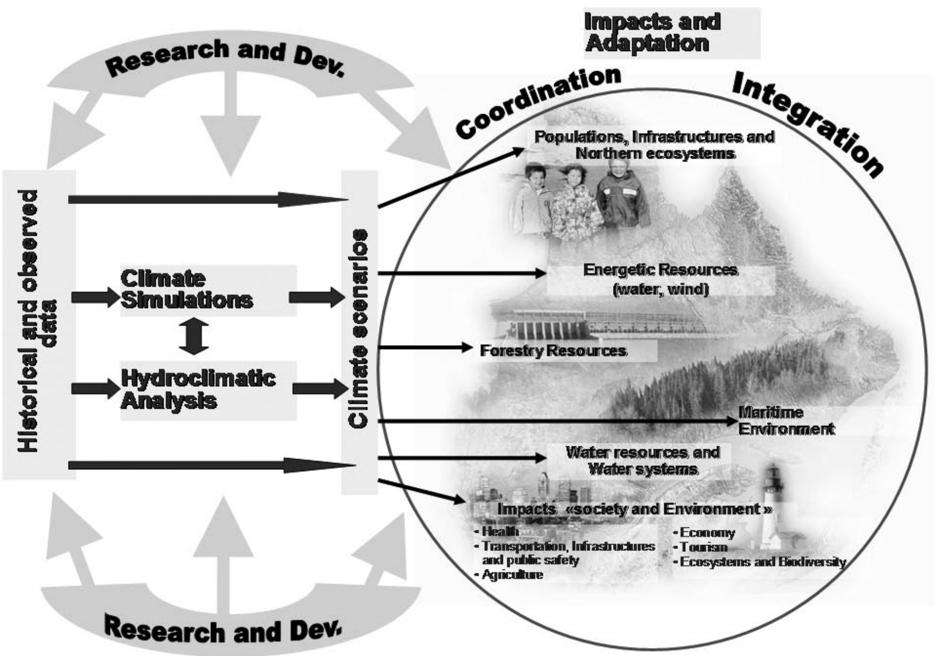
FIGURE 1. Ouranos: geographic coverage and scientific programs and projects



ТРАДИЦИОННОЕ ПРИРОДОПОЛЬЗОВАНИЕ КОРЕННЫХ МАЛОЧИСЛЕННЫХ НАРОДОВ — МЕЖДУНАРОДНЫЕ И НАЦИОНАЛЬНЫЕ ВОЗМОЖНОСТИ СОХРАНЕНИЯ

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Keywords: Indigenous peoples, traditional knowledge, practice and innovations, arctic and forest biodiversity

INTRODUCTION

В рамках Конвенции о биологическом разнообразии до сих пор не найдены подходящие индикаторы, которые смогли отразить процесс сохранения традиционных знаний, практики и инноваций коренных народов. В то же время мировой опыт свидетельствуют, что без сохранения традиционных знаний, без применения специальных мер по поддержанию традиционного природопользования, при отсутствии эффективной законодательной защиты у коренных малочисленных народов нет шансов сохранить себя как самостоятельные этносы.

Традиционное природопользование – один из важнейших элементов исторически сложившегося образа жизни коренных народов. Характерные особенности географической среды (климат, рельеф, гидрография, флора, фауна, характерные ландшафты) сформировали определенные типы жизнеобеспечения коренных народов. Именно поэтому традиционное природопользование включает в себя знания, опыт и инновации, и может рассматриваться как исторически сложившиеся неистощительное природопользование, где условия, пути и способы использования объектов животного мира, пищевых и лекарственных растений, морепродуктов, других природных ресурсов аборигенными малочисленными народами должны быть защищены от исчезновения.

RUSSIAN INDIGENOUS PEOPLE AND BIODIVERSITY

В Российской Федерации официально признаны 45 коренных малочисленных народов, жизнедеятельность 40 народов связана с суровыми условиями проживания на крайнем Севере, в Сибири и Дальнем Востоке России. Основа для признания самобытности этих народов заключается в признании у них особых исторически сложившихся способов хозяйствования, особой культуры и специфичной социально-экономической организации жизнедеятельности общин.

Россия играет особую роль в сохранении биоразнообразия на планете, вследствие своей площади, географического положения и ресурсов. К российскому сектору относится около трети всей площади Арктики, и именно здесь находятся территории, наиболее ярко воплощающие типичные черты арктических зональных комплексов экосистем (Figure 1). Основные пространства России занимает таежная зона, территория господства бореальных хвойных лесов. На протяжении нескольких тысяч километров вдоль границ России тянется горная страна, которая отделяет таежную Сибирь от пустынно-степной Центральной Азии. Биологическое ресурсы морей, омывающих Россию, спасают от голода сотни миллионов людей во всем мире, очень важны также для коренных народов — рыболовов и охотников на морского зверя. Все это биотическое разнообразие прекрасно было известно коренным народам с незапамятных времен.

Среди традиционных укладов и типов природопользования коренных народов можно выделить две большие группы - пастбищных скотоводов и промысловиков. Среди скотоводов мы отмечаем как традиционные только кочевников — оленеводов. А вот к традиционному промысловому природопользованию коренных народов Севера относятся такие виды деятельности, как морзверобойный и охотничий промыслы, рыболовство, собирательство дикоросов и др. (Figure 2).

TRADITIONAL KNOWLEDGE, PRACTICE AND INNOVATIONS

К кочевым оленеводам можно отнести следующие народы: ненцы (1) и часть коми-зырян (2) на Европейском и З- Сибирском Севере, большая часть чукчей (3) на Чукотке. Близки к ним северные группы якутов (4), коряки (5), кереки (6) и саамы (7). Для них олень - источник питания, одежды, материал для строительства жилья (чумы и яранги), базовая основа хозяйства и престижа оленевода. Основу питания у оленеводов традиционно составляло мясо. Характерная черта этого вида природопользования - широкие сезонные миграции между тундрами и северной тайгой. Все домашнее хозяйство в основном переносное, перевозится на оленьих упряжках как в период сезонных миграций между тайгой и тундрой, так и по мере смены пастбищ внутри сезона (фото - оленеводов). При сохранении традиционного образа жизни, рыба также играет существенную роль в питании кочевых оленных народов при длительных остановках у рыбных рек и озер.

Охота — древнейшее занятие человечества, и многие оленные охотники кочевали на огромных просторах Сибири с исторических времен. Это - нганасане (12) и энцы (13) в тундрах Таймыра, эвенки (14) и эвены (15) на огромных территориях Средней и Восточной Сибири и Дальнего Востока, часть хантов (16) и манси (17) в западносибирской тайге, ряд малочисленных народов Сибири (селькупы-18, долганы-19, тофалары- 20) и Дальнего Востока (юкагиры-21, негидальцы-22, ороки-23, чуванцы- 24).

Всех их отличает древняя культура, наследуемая из неолита. Домашний олень такие народы используют практически исключительно как транспортное животное, на еду их использовали в исключительных случаях. Собака была и остается главным помощником в охотничьем ремесле. Как профессиональные охотники, аборигены бережно относятся как к своим угодьям, так и к животным, на которых охотятся. Традиционная основа питания - мясо диких копытных, птиц. Рыба имеет второстепенное значение, но с переходом на оседлый образ жизни ее роль растет.

Северное и таежное промысловое хозяйство на больших территориях базируется на ведении промысловой охоты в сочетании с сезонным рыболовством и заготовкой леса. Из других народов к этому типу можно причислить хозяйство телеутов (40) и орочей (41). По характеру воздействия на природу эти наследники тунгусских народов близки к оленным охотникам, но в Приамурье и Забайкалье под влиянием южных соседей часть эвенков используется не столько олени, а лошадь.

Другая группа коренных народов, которые к настоящему времени также как и кочевники-оленеводы сильно зависят от животных и следовательно от глобальных изменений климата, это морские охотники. На карте показаны районы проживания - эскимосов (8) и чукчей (9), алеутов Командорских островов (10). Традиционно летом они жили в жилищах из шкур, зимой - в землянках, позже такие жилища заменили бревенчатые дома. В питании основную роль играет мясо морского зверя, большую роль играет и рыба, а также мясо добытых птиц и сухопутных животных (особенно дикого северного оленя).

Народы-рыболовы: часть хантов (16) в Западной Сибири, чулымцы (25), кеты (26) на Енисее, ряд малочисленных народов Амура (ульчи-27), Сихотэ-Алиня (удэгейцы-28) и Камчатки (ительмены-29, камчадалы-30), Сахалина (нивхи-31). Основное средство передвижения здесь различного типа лодки. Орудия лова крайне разнообразны - от самых современных спиннингов и сетей до традиционных систем специальных плотин на озерных системах и “морд” из ивовых прутьев. Основу питания, естественно, составляет рыба, но и здесь также активно охотятся на водоплавающих птиц и диких копытных.

CURRENT SITUATIONS

Современные проблемы, связанные с развитием традиционного природопользования коренных малочисленных народов России, представляют собой сложный комплекс правовых, этнологических, экономических, социальных и экологических проблем. Это стало заметным в последние полтора столетия, и особенно в ряде регионов севера Европейской части, в Сибири и на Дальнем Востоке. Для выяснения сохранности традиционных знаний, инноваций и возможностей поддержания традиционного образа жизни коренных народов России был проведен специальный опрос в рамках осуществления the Indigenous Peoples' Network for Change (IPNC), совместной инициативы Russian Association of the Indigenous Peoples of the North и the International Alliance of Indigenous and Tribal Peoples of the Tropical Forests. Всего было получено 15 ответов, практически из всех районов современного проживания и ведения хозяйственной деятельности коренных народов (Figure 1).

По результатам опроса по состоянию сохранности традиционного природопользования экспертами из регионов проживания коренных народов было отмечено, что наиболее профессиональным занятием в сфере природопользования является оленеводство (Figure 3). Противоположное значение отмечено для такого вида деятельности как - сбор дикорастущей продукции и некоторых других видов собирательства (так на севере Якутии собирают мамонтовую кость). Эта форма природопользования почти утратила функции основного традиционного занятия, но представляет для коренного населения существенный дополнительный источника продуктов и семейных доходов. Роль охоты и рыболовства для жизнедеятельности коренного населения распределяется в пропорции 50/50 (между основным доходом и дополнительными источниками средств для жизни). Любопытно, что такие функции как отдых, развлечение или иная необязательная значимость указывается экспертами практически для всех типов природопользования, кроме морского зверобойного промысла.

CONCLUSION

Проведенный опрос в регионах проживания и хозяйственной деятельности коренных народов России показал, что накопленные традиционные знания, практика и инновации сохранились на обширных территориях Севера, Сибири и Дальнего Востока России. В тоже время отмечается деградация экосистемных услуг и истощение биологических ресурсов во многих регионах страны. Несмотря на то, что для аборигенных знаний характерна высокая устойчивость этнических традиций, в современных условиях глобальных природных и антропогенных изменений необходимы специальные меры для их сохранения и поддержания традиционного образа жизни.

The following is an unofficial English translation provided as a courtesy by the SCBD.

TRADITIONAL NATURAL-RESOURCE USE AND INDIGENOUS PEOPLES — INTERNATIONAL AND NATIONAL OPPORTUNITIES

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Keywords : Indigenous peoples, traditional knowledge, practice and innovations, arctic and forest biodiversity

INTRODUCTION

The Convention on Biological Diversity has not yet found suitable indicators that can reflect the conservation of traditional knowledge, practices and innovations of indigenous peoples. At the same time, international experience shows that without the protection of traditional knowledge, without special measures such as effective legal protection, Indigenous People have no chance of surviving as distinct ethnic groups. Traditional management is a critical component of the historical way of life of indigenous peoples. Characteristics of the geographical environment (climate, topography, hydrography, flora, fauna, unique landscapes) form certain lifestyles of indigenous peoples. Traditional management includes local expertise and innovation, and preserving it could be viewed as historical conservation management, and conditions, the ways and means of use of animal food and medicinal plants, fish and other natural resources of the small indigenous peoples should be protected from extinction.

RUSSIAN INDIGENOUS PEOPLE AND BIODIVERSITY

The Russian Federation has officially recognized 45 indigenous people, 40 of which are linked to the harsh living conditions in the far north, Siberia and Far East Russia. The basis for recognition of these people is to recognize their distinctive historical ways of doing business, especially the culture and specific economic and social life of communities.

Russia plays a special role in the preservation of biodiversity on the planet, because of its size, geographical location and resources. The Russian sector is about a third of the total area of the Arctic, and the territory, most vividly embodies the typical characteristics of the Arctic Area complex ecosystem (Figure 1). The majority of the area is zoned as Taiga, and the territory is dominated by boreal coniferous forests. For several thousands of kilometers along the borders of Russia mountainous country stretches and separates the Siberian desert and the steppe of Central Asia. The biological resources of the seas surrounding Russia, which have saved hundreds of millions of people worldwide from starvation, are very important to indigenous peoples, fishermen and hunters of sea mammals. All this biotic diversity has been well-known to indigenous people since time immemorial. Among traditional ways and types of management of indigenous peoples are two major groups - pastoral herders and fishermen. Among the pastoralists, we note the traditional solely-nomadic reindeer herders. Traditional fishing management of Indigenous Peoples of the North includes activities such as nature and fishing industries, fishing, gathering wild, etc. (Figure 2).

TRADITIONAL KNOWLEDGE, AND INNOVATIONS TO PRACTICES

Nomadic reindeer herders include the following peoples: Nenets (1) and some komi-zyryan (2) of the European and the Western-Siberian North, most of the Chukchi (3) in Chukotka, and the related northern groups of Yakuts (4), Koryak (5), Kerek (6) and Sami (7). To them, deer are a source of food, clothing, shelter material (plaque and yarangi), the basic framework for management and the prestige of reindeer herding. Their traditional food has been the meat. It is a characteristic of this type of environment-wide seasonal migration between the tundra and northern taiga. All households are mostly portable, carried on reindeer sleighs during seasonal migrations between taiga and tundra, and as the pasture changes in the season (photo-reindeer herders).

While maintaining their traditional way of life, fish also play a significant role in nutrition of the nomadic reindeer-herders who take long stops at rivers and lakes for fishing. Hunting is the oldest occupation of mankind, and many reindeer hunters migrated across vast distances of Siberia throughout historic times. These are the Nganasane (12), and Enets (13) in the tundra Taimyr and Evenk (14) and (15). Even in the vast territories of Central and Eastern Siberia and the Far East, some (16) Khanty and Mansi (17) in the west Siberian taiga, a number of small peoples of Siberia (Selkups-18-19 Okrug, tofalary- 20) and the Far East (Lower-21, Negidals-22 - 23 Oroks, chuvantsy- 24). All share a ancient culture inherited from the Neolithic times. The domestic reindeer is used by these peoples practically solely for transport, but has been used for food in exceptional circumstances.

Dogs have been chief assistants in the hunting field. As a professional hunter, they are sensitive to both their land and animals to hunt. Traditional food-meats are wild ungulates birds. Fish is of secondary importance, but its role is growing. North taiga and fishing economies of large areas are based on the conduct of commercial hunting coupled with seasonal fishing and logging. Other peoples with this type of economy include Teleut (40) and Prime (41). The nature of the Tungus people, close to the Reindeer hunters, has been impacted, but in the Amur region and the Baikal region (a southern neighbour of the Evenks) they do not use as much deer, and only some horses.

Another group of indigenous people who are heavily dependent on animals, and therefore are impacted by global climate change, are sea hunters. The map shows areas - Eskimo (8) and (9) the Chukchi, Aleut Commander Islands (10). Traditionally, they lived in homes of skins and in winter in mud-huts, later replaced by log homes and such. A major part of their nutrition comes from sea mammals, as well as fish, and meat products from birds and land animals (especially northern wild deer) also play big roles in their nutrition.

Fishing peoples: Some Khanty (16) in Western Siberia, Chulyms (25), Ketas (26) on the Yenisei, some minorities (Ulchas-27), Sihote-Alinya (Udehe-28) and Kamchatka (Mansi, 29, inhabitants - 30), Sakhalin (Nivkhs-31). The people transport themselves using different types of boats. Fishing methods are very diverse, ranging from sophisticated spinners and nets to traditional systems of dams on lakes and willow branch "mords". The food, of course, is fish, but they also actively hunt waterfowl and wild ungulates.

CURRENT SITUATIONS

Contemporary issues related to the development of traditional natural-resource use by the Indigenous Peoples of Russia, consists of a complex set of legal, ethnological, economic, social and environmental problems. This was evident in the last half-century, notably in some regions of northern Europe, Siberia and the Far East.

To study the preservation of traditional knowledge, innovations, and the ability to maintain the traditional way of life of indigenous peoples of Russia, a special survey was taken of the implementation of the Indigenous Peoples' Network for Change (IPNC) joint initiative of the Russian Association of Indigenous Peoples of the North and the International Alliance of Indigenous and Tribal Peoples of the Tropical Forests. A total of 15 responses received from almost all areas of modern living and business environment for indigenous people (Figure 1). According to the poll results as preservation of traditional land use experts from the indigenous regions, it was noted that the most professional environmental management training is on reindeer (Figure 3). The opposite was important for such activities as collecting wild products, and some other types of gathering (peoples in the north of Yakutia collect mammoth bone). This form of management has almost lost its role as a basic traditional occupation, but for the indigenous population it still represents a significant additional source of family income. The role of hunting and fishing in sustaining the indigenous population is 50/50 between main and additional sources of income. Ironically, activities such as recreation, entertainment or other non-value activities were indicated by experts for almost all types of management, in addition to sea-mammal hunting.

CONCLUSION

A survey in the life and economic activities of indigenous peoples Russia showed that an accumulation of knowledge, practices and innovations have survived in large areas of the North, Siberia and Far East Russia. At the same time, there was a degradation of ecosystem services and biological resources in many parts of the country. Despite the fact that indigenous knowledge has a high resistance of ethnic traditions, in the current context of global natural and human-induced changes management is needed to preserve and maintain their traditional lifestyles.

AGRICULTURAL BIODIVERSITY AS A TOOL FOR CLIMATE CHANGE ADAPTATION IN THE AGRICULTURE SECTOR: A KNOWLEDGE-MANAGEMENT APPROACH OF THE FOOD AND AGRICULTURE ORGANIZATION (FAO)

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Keywords: agricultural biodiversity, climate change adaptation, knowledge-management, online resource, FAO.

The importance of agricultural biodiversity in food security and agriculture has been widely recognised within the framework of the Convention on Biological Diversity (CBD) and other international fora such as the Commission on Genetic Resources for Food and Agriculture (CGRFA). Moreover, the international community is increasingly considering the role played by agricultural biodiversity with respect to its functions in climate change adaptation within the agriculture sector, as agro-ecosystems characterised by a high diversity at both the species and the gene levels have much greater potential to adapt to climate change (FAO, 2007). On the basis of its global field expertise, the Food and Agriculture Organization (FAO) promotes the conservation and sustainable use of agricultural biodiversity as an important tool in climate change adaptation. Effective and comprehensive knowledge-management is here illustrated as an FAO approach in addressing climate change adaptation through agricultural biodiversity.

The conservation and the sustainable use of agricultural biodiversity in a changing climate requires *in situ* and *ex situ* actions based on scientific data and information as well as traditional knowledge on issues ranging from plant and animal genetic resources to ecological monitoring. The online FAO Knowledge Forum (http://www.fao.org/KnowledgeForum/index_en.htm) provides an entry point to thematic knowledge networks, numerous databases and other web-resources to identify relevant data and share information related to the conservation and management of agricultural biodiversity as an adaptation tool. Examples of these databases and other online resources are reported in Table 1.

Relevant case studies and best practices are also disseminated through the FAO Knowledge Forum, publications and training initiatives. In this context, the case studies on the ecosystem approach in agriculture (e.g. FAO, 2003) are discussed to understand the linkages between the management of biodiversity and the adaptation to climate-related environmental degradation.

References

FAO (2003). *Biodiversity and the Ecosystem Approach in Agriculture, Forestry and Fisheries* (http://www.fao.org/DOCREP/005/Y4586E/Y4586E00.HTM)

FAO (2007) *Adaptation to climate change in agriculture, forestry and fisheries: Perspective, framework and priorities* (ftp://ftp.fao.org/docrep/fao/009/j9271e/j9271e.pdf)

TABLE 1: Examples of FAO databases and online resources.

Name	Description	Link
CLIMWAT	CLIMWAT is a climatic database to be used in combination with the computer program CROPWAT and allows the ready calculation of crop water requirements, irrigation supply and irrigation scheduling for various crops for a range of climatological stations worldwide.	http://www.fao.org/ag/agl/aglw/climwat.stm
DAD-IS	DAD-IS is the Domestic Animal Diversity Information System hosted by FAO. It is a communication and information tool for implementing strategies for the management of animal genetic resources (AnGR). It provides the user with searchable databases of breed-related information and images, management tools, and a library of references, links and contacts of Regional and National Coordinators for the Management of Animal Genetic Resources. It provides countries with a secure means to control the entry, updating and accessing of their national data.	http://dad.fao.org/
ECOCROPS	Ecocrop can identify plants for a specified environment, with a specific growth habit and for a defined use. The user enters local environmental data such as temperature range, rainfall, soil characteristics etc., defines the growth habit required (climber, prostrate etc.) and use - such as food or medicinal and searches the database for a list of plants adapted to the parameters set.	http://ecocrop.fao.org/
WLSR	The World List of Seed Resources (searchable by crop, country, institution and city) comprises about 8 000 public and private institutions dealing with seed production and processing in over 150 countries are recorded, with a list of major crops per institution.	http://www.fao.org/ag/agp/agps/seed/wlssd.htm
TEMS	The Terrestrial Ecosystem Monitoring Sites database, is an international directory of sites (named T.Sites) and networks that carry out long-term, terrestrial in-situ monitoring and research activities.	http://www.fao.org/gtos/tems/
WIEWS	The World Information and Early Warning System (WIEWS) on Plant Genetic Resources for Food and Agriculture (PGRFA), has been established by FAO, as a world-wide dynamic mechanism to foster information exchange among Member Countries, by gathering and disseminating information on PGRFA, and as an instrument for the periodic assessment of the state of the world's PGRFA.	http://apps3.fao.org/wiews/wiews.jsp?i_l=EN
FRA 2005	Global Forest Resources Assessment 2005 is the most comprehensive assessment of forests and forestry to date, covering 229 countries and areas for the period 1990 to 2005. It examines the current status and recent trends for about 40 variables covering the extent, condition, uses and values of forests and other wooded land. The variables measured in FRA 2005 with relevance to biological diversity include: area of primary forest; forest area designated for conservation of biodiversity; composition of forests; number of native tree species; threatened forest tree species.	http://www.fao.org/forestry/site/fra/en

TAXONOMY, CHANGING BIODIVERSITY AND THE 2010 TARGET: CONTRIBUTIONS FROM THE EDIT NETWORK TO THE GTI

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Keywords: Global Taxonomy Initiative, biodiversity loss, taxonomic research, collections, expertise, infrastructures, IT, capacity building

INTRODUCTION

Measuring biodiversity change implies a sound taxonomic basis, which presently is very far from sufficient to fulfil the needs. Overcoming the taxonomic impediment involves both having enough trained taxonomists and having taxonomic information available to those who need to use it. The European Distributed Institute of Taxonomy project, EDIT, is a European Commission sponsored Network of Excellence aimed at starting to overcome the taxonomic impediment through collaboration, integration and a joint work programme (http://www.e-taxonomy.eu). Through EDIT we hope to build capacity globally and provide information and tools for use by all. The EDIT proposal is an initiative of the Consortium of European Taxonomic Facilities (CETAF) which since 1996 has been working for better integration of the taxonomic effort in Europe.

Providing taxonomic tools for measuring biodiversity change

At present the baseline for measuring biodiversity loss in terms of species number is fuzzy. Basically the causes lie in incompleteness of existing knowledge about species, in the low rate of production of new taxonomic knowledge, and in poor availability of knowledge for analyses.

EDIT addresses these points through an approach based on taxonomic research, collections and IT. Indeed documented specimens housed in taxonomic collections provide the only objective testimony of the occurrence of any species in any place at any time, and collections have already proved their value in this respect by allowing descriptions of new species, including in Europe, which have become extinct since sampled and would have remained forever unknown if specimens had not been preserved.

Providing the baseline for measuring biodiversity change also implies long term reference "all taxa inventories" in selected sites, based on standards and protocols which allow repetition and measurement of change. EDIT aims at establishing such standards, and at organising the European taxonomic force in pilot operations within and outside Europe.

EDIT also addresses the presently too slow rate of descriptions of unknown species, which probably constitute the majority of living species and of which knowledge is needed to evaluate the condition and functioning of ecosystems. EDIT aims at organising taxonomic work in a new way, by encouraging taxonomists to work more collectively with new web-based informatics tools.

The approach of EDIT to overcome the impediments regarding inventories, taxonomic revisions, and utilisation of collections for long term monitoring of biodiversity relies on the development of informatics tools that make full use of the facilities provided by the world wide web. The objective is to build up an Internet Platform for Cybertaxonomy, which will make interoperable the various existing components of the taxonomic activities and infrastructures, and will make them openly and freely available world wide. The EDIT activities will contribute to building up LifeWatch, the project for a new European very large distributed infrastructure for biodiversity information and analysis, and to the overarching Global Biodiversity Information Facility (GBIF).

The EDIT consortium

Muséum national d'Histoire naturelle — Project Leader (FR) ; Natural History Museum of Denmark, University of Copenhagen (DK); Consejo Superior de Investigaciones Científicas (ES); University of Amsterdam (NL); National Herbarium Netherlands (NL); Natural History Museum Naturalis (NL); Centraalbureau Schimmelcultures (NL); Freie Universitaet Berlin — Botanical Garden and Botanical Museum (DE); Natural History Museum, London (UK); Royal Botanical Gardens Kew (UK); Staatliches Museum für Naturkunde, Stuttgart (DE); Royal Belgian Institute of Natural Sciences (BE); Royal Museum for Central Africa, Tervuren (BE); National Botanic Garden of Belgium (BE); Museum and Institute of Zoology, Polish Academy of Sciences (PL); Institute of Botany, Polish academy of sciences (PL); Hungarian Museum of Natural History (H); Comenius University, Bratislava (SL); Institute of Botany, Slovakian Academy of Sciences (SL); Institut National de la Recherche Agronomique (FR); Society for management of European biodiversity data (IR); Species 2000 (UK); Komarov Botanical Institute of the Russian Academy of Sciences (RU); Zoological Institute of the Russian Academy of Sciences (RU); Missouri Botanical Garden, St Louis (USA); US National Museum of Natural History, Smithsonian Institution, Washington (USA)

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AVOIDED DEFORESTATION, LAND USE, LAND USE CHANGE AND FORESTRY

BIOSPHERE-ATMOSPHERE HOTSPOTS AND ECOSYSTEM TRADING

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Key words: Climate change, Forests, Ecosystem services, Trading

INTRODUCTION

80-90% of the earth's above ground carbon biomass is in forests, with tropical forests storing 150-350 tonnes of carbon per hectare. 18/20% of global Greenhouse gas (GHG) emissions are from deforestation and are likely to negate most of the carbon savings to be made under the Kyoto Protocol unless they are mitigated (Stern, 2006). The Global Canopy Programme (GCP) proposes a new large-scale practical tool for conservation enabling regional to global scale ecosystem services provided by tropical forest canopies to be traded in financial markets. Science will be employed to quantify the ecosystem services, environmental economists will evaluate them and Governments will set the policy framework. The model will deliver sustainable revenues for mitigating carbon emissions, applying adaptation measures and improving livelihoods on a scale which exceeds traditional conservation and complement proposals for compensated reduction of deforestation (Santilli, 2005).

FOREST ECOSYSTEM SERVICES

The forest canopy is the functional interface between 90% of the earth's rich and complex terrestrial biomass and the atmosphere. Forest canopies harbour 40% of global biodiversity, influence the hydrology of more than 45 million ha of land by controlling evapotranspiration and intercepting up to 25% of precipitation (Ozanne, 2003). They store between 150-350 tons of carbon per ha, which is released to the atmosphere when the forest is converted to pasture. Volatile Organic Compounds (VOCs) emitted from forest canopies are likely to be responsible for the production of 'green ocean clouds,' which distribute gentle rain across areas such as the Amazon (Ozanne, 2003). This virtuous cycle is also disrupted by forest conversion. Pollination services have been valued at U.S.$12 billion per annum (Costanza, 1997). Forests around coasts, are capable of pumping atmospheric moisture from the ocean inland in amounts sufficient for the maintenance of optimal soil moisture stores, compensating the river runoff and ensuring maximum ecosystem productivity (Makarieva, 2007). In the absence of forests, precipitation declines exponentially, leading to droughts and ultimately desertification. All of these services are produced by tropical forests and in particular in the major 'biosphere-Atmosphere hotspots' of Amazonia, West and Central Africa, Southern India and South East Asia but their scientific and economic evaluation is currently poor.

HOW CAN CONSERVATION REALISTICALLY STAND UP TO COMMERCIALISM?

Economics is in a crisis of values in its relationship with the natural world. Biologists have largely failed to identify services that biodiversity provides which are recognisable economically, nor adequately compete with the business or political realities in developing countries. As a result forest conversion proceeds apace, the sixth extinction looms ahead and the effects of landscape change threaten environmental security at local to global scales. What new opportunities lie before humanity which can offer hope? By linking the ecosystem services biodiversity provides with carbon storage and climate change, a possible solution may emerge. New research suggests, interactions between the forest canopy, its biodiversity, and the atmosphere are more complex than first recognized and have considerable economic value. Large forests and possibly biologically active parts of the oceans, may interact with the atmosphere through the release of volatile organic compounds as well as through the exchange of gasses, water vapour, and in addition to the storage or sequestration of carbon (Andrea 2000). In forests the role of biodiversity in these mechanisms is poorly known, due in part to the lack of major canopy access facilities across the tropics.

VALUING AND TRADING FOREST ECOSYSTEM SERVICES

A new proposed network of 'whole forest observatories' set in proposed the Biosphere-Atmosphere hotspots, backed by UNEP and by GEF, could provide a leap forward in our knowledge of forest canopy interactions with the atmosphere and the potential benefits to local livelihoods from access to forest canopy biodiversity and its ecosystem services. Better quantification of these services both scientifically and economically opens up the possibility of adding considerable value to proposed trading in carbon credits for avoided deforestation. The GCP has proposed the VivoCarbon Initiative (Mitchell 2006), the creation of a global market in ecosystem services provided by forest stocks, held by known landowners. The services including water and carbon storage, rainfall generation, VOC production, climate buffering, and biodiversity protection should be quantified scientifically, evaluated economically and then offered to potential buyers within agreed Governmental laws and policy frameworks. Such ecosystem trading offers a potential source of capital that could provide alternative land use options in biodiversity rich developing nations leading to significant reductions in the rates of forest conversion globally. Scientists must play a role in identifying the mechanisms underlying the ecosystem services that will become tradable in the future and can also assist in moving the dialogue forward. The GCP is actively engaged with the Government of Amazonas state's "Amazonas Initiative" (Viana, 2006) to develop a large-scale model surrounding the valuation and trading of forest canopy ecosystem services, as a mean of delivering benefits to local livelihoods which helps conserve carbon in forests.

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AUCTIONING PLANT BIODIVERSITY: RESULTS OF A GERMAN CASE STUDY

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Keywords: Auctions, plant biodiversity, outcome orientation, ecological services, EAFRD-Regulation

INTRODUCTION

Agriculture plays an important role in protecting plant biodiversity in the rural environment and since the reform of the Common Agricultural Policy (CAP) in 1992 agri-environmental schemes have been supported by the EU within the framework of the second pillar of the CAP. However ecological services provided by agriculture still are predominantly rewarded action-orientated and by the use of fixed-price payments. This implies particular ecological and economic disadvantages; especially against the background of the necessary examination of agricultural subsidies. Thus for the advancement and improvement of agri-environmental programs, a transdisciplinary payment scheme to reward ecological services in agriculture was developed, which differs fundamentally from the status quo of agri-environmental programs and took place in Lower Saxony, Germany.[1] It is outcome-based, integrates market-similar elements by the use of auctions and is embodied at a regional level, considering the EU-principle of subsidiarity.

From an economics point of view, the main focus deals with is an efficient accomplishment of ecological objectives (plant species richness and composition in managed grassland), which in the case study were defined as ecological goods 'grassland I', 'grassland II' and 'grassland III', with class 'grassland III' being the highest quality. In the following the use of auctions as the mayor component of the payment scheme will be described and beyond that, the main results from two auctions in a case study area (the county of Northeim) will be discussed.

AUCTIONS — A NEW TOOL IN THE EU'S AGRI-ENVIRONMENTAL POLICY

Although the problem of increasingly endangered plant biodiversity is to a growing extent recognized, the question of how to address this challenge appropriately has yet to be answered. One of the suggested approaches is the strengthening of incentive measures and market-creation. The European Union's Council Regulation (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) has introduced auctioning as a new instrument for granting agri-environmental payments and awarding conservation contracts for the recent multi-annual budgetary plan (2007-2013): "Where appropriate, the beneficiaries may be selected on the basis of calls for tender, applying criteria of economic and environmental efficiency" (article 39, Council Regulation (EC) No 1698/2005). However, in the range of policy options aimed at the conservation and protection of biological diversity, market-based instruments have only recently gained attention. This abstract focuses the specific mechanism of auctioning contracts in biodiversity protection efforts, which – even though not yet widely applied – is very promising from a cost-effectiveness perspective.

Theoretically the potential benefit of auctioning contracts is evident and well analysed by the auction theory. The main reasons why auctions are of interests in this case are the following: First, the traded ecological goods are non-market goods which have no standard value and in some kind of way a public demand and valuation is needed. The second reason to be mentioned is the presence of an information asymmetry between the farmers and the administration. Farmers know better how participating in agri-environmental programs would affect

1 The research project was funded by the German Federal Ministry of Education and Research.

their production and income. So they will calculate based on their individual costs and a price for the trades goods will emerge. This enables a possibility for a more efficient use of public funds as if the administration would fix a unique premium, not knowing the farmers' costs of production.

The use of auctions has a longstanding tradition in government procurement contracting, but has mainly been limited to trade commodities as for example electricity and emission rights. Since 1986 the United States Department of Agriculture has been awarding land retirement contracts for the Conservation Reserve Program (CRP) for the first time based on a competitive bidding mechanism. Farmers make offers to obtain CRP cost share assistance, which is allocated to them based on a so called Environmental Benefits Index. In Australia, as another example, auctions are used in areas such as salinity control, nutrient control and conservation of existing vegetation where land use change is required to achieve environmental improvement.

In the case of plant biodiversity in Europe, it is mainly the question to develop conservation-compatible land use policies to influence private land management. In recent years, governments have employed a number of different mechanisms in this context. Among the most common were fixed-price grants, tax incentives, voluntary schemes, etc. Using auctions to conserve natural resources is a relative new concept and there is an urgent need for research prior to its implementation especially into the CAP 2007 – 2013 and beyond.

RESULTS

To attend the auction, farmers had to submit an individual offer for every grassland site. The offer includes the choice of the ecological good (grassland I, II or III), the calculation of the price per hectare and a description of the grassland site. Main results from two first-price sealed-bid, price discriminating auctions, which took place in a case study area, are presented in table 1.

The results of both auctions point out that in fact much differentiated offers were made by the farmers in the model-region. Even though the auctioning scheme is a comparatively simple case study without using an environmental benefits index, the results are sufficient to point out a substantial potential for cost reductions in comparison to more traditional measures in environmental and biodiversity conservation policy. As an indicator for a high and even growing acceptance of auctions from the farmers' perspective, the number of submitted sites arose from the auction 2004/2005 to the second auction which took place in early 2006. Therefore this research project can be seen as a proof of how promising market-based approaches are and it is obvious that the empirical work indicates cost advantages of auctioning in comparison to fixed price schemes of up to 36 %, depending on which scenario is chosen as a reference.

Even though the case study presented has yielded more than promising results while a real life auctioning format was successfully implemented in a model region and well accepted by farmers, there are a number of long-run aspects (e.g. to analyse the dynamic and development of the prices during further auctions) yet to be considered and included in the planning of a conservation program based on auctioning.

TABLE 1: Main results of the case study (submitted offers)

	1st auction (2004/2005)	2nd auction (2006)
Grassland I		
- Range of prices in € per hectare	40 – 250 (Ø 101)	25 – 160 (Ø 94)
- Number of sites	130	216
- Hectare	221	341
Grassland II		
- Range of prices in € per hectare	55 – 300 (Ø 142)	75 – 300 (Ø 148)
- Number of sites	32	56
- Hectare	53	83
Grassland III		
- Range of prices in € per hectare	100 – 350 (Ø 203)	150 – 450 (Ø 257)
- Number of sites	18	23
- Hectare	37	32

BIOFUELS AND GENETICALLY ENGINEERED TREES: IMPACTS ON FOREST BIODIVERSITY

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Keywords: Biofuels, Genetically Engineered Trees, Plantations, Indigenous Peoples, Global Warming

INTRODUCTION

With concerns over global warming and energy security mounting, governments and industries have begun a headlong plunge towards the development of biofuels. The E.U. has mandated that 10% of transportation fuels be derived from plant biomass by 2020. In the U.S., George Bush stated a goal of replacing 20% of U.S. transportation fuel with ethanol by 2017. Brazil is already producing 40% of transportation fuels from sugar cane ethanol and soya biodiesel.

Because the most energy rich plant feedstocks grow in tropical climates, the expansion of biofuel production for export is impacting tropical countries most heavily. Land is increasingly being used to produce energy crops for export to wealthy northern countries, forests are being cleared, and indigenous peoples are being displaced from their traditional lands.

Biofuels are not the answer to reducing carbon emissions.

When the entire lifecycle analysis is considered, biofuels do not reduce carbon emissions as much as we hoped. Production of biodiesel and bioethanol both involve large energy inputs. For example, growing corn requires tilling and planting, transport and application of oil-derived fertilizers, herbicides and pesticides, harvest, transport of raw biomass to a refinery, processing, often fueled by coal, and transport to point of use. When all factors are included, the net savings is drastically reduced. The precise balance of these equations depends on the feedstock used, how far it is transported and farming and refinery techniques. In some cases, per unit of energy, biofuels produce *more* carbon than fossil fuels. (Patzek, 2005)

The net carbon release from biofuel production is drastically increased when native forests are first cleared, as this releases the stored carbon in the forest biomass and eliminates future storage potential. For example, Southeast Asian peat forests are the earth's largest carbon storage ecosystems, yet are being cleared and burned for oil palm. As a result, 2 billion tons of CO2, equivalent to 8% of the global annual total of fossil fuel emissions are released from this area which accounts for only 0.2% of the earth's surface. This has made Indonesia the world's third largest emitter of CO2, even though much of the population lives in poverty, and the palm oil is exported to Europe. (Hooijer, A, 2006)

Deforestation, Loss of Biodiversity and Destruction of Indigenous Communities

Biofuel feedstock production is driving the destruction of native forests, eliminating the carbon storage potential of the land and contributing to the loss of forest biodiversity. Monoculture plantations do not provide habitat for native species.

In Brazil, soy production is responsible for more deforestation in the Amazon than logging or cattle ranching. In this region, one hectare of land can absorb 20 tons of CO2 if it remains forested. If cane and soy plantations continue to spur deforestation in Brazil, any climate advantage is more than outweighed by the loss of the forest. (Ortiz, 2006) Already two thirds of Brazil's "Cerrado", a unique, biodiverse ecosystem, has been converted to cane plantations. In the Amazonian rainforest, the rate of deforestation is directly linked to the price of soya. Forested areas are often first burned off, releasing all of the carbon stored in the forest biomass. Brazil expects to triple ethanol production in the next 7 years. (MST, 2007)

In Brazil's Atlantic Forest state of Mato Grosso, the remaining 420 or so Enawe Nawe Indians declare that "soya is killing us", as their traditional forested lands have been converted to soy plantations (Won Ho, 2006). In Ecuador. the Awa live in the last remaining large tract of coastal lowland rainforest, part of the Chaco area biodiversity "hotspot". They have lived peaceably with neighboring Afro-Ecuadorian peoples until recent pressures from logging and palm oil plantation companies have claimed much of the indigenous lands. Ecuador is the second largest producer of biodiesel in Latin America, and intends to increase production over 50% in the next 5 years.

In Argentina, more than 500,000 hectares of forested land were converted to soya agriculture between 1998 and 2002. In Nicaragua, an area of 200,000 hectares of forested land within the Region Autonoma del Atlantico Norte (RAAN), is slated for development of monoculture plantations of palm oil for biodiesel.

China recently scaled back grain ethanol production in recognition of the conflicting need to feed a large population. However, China's alternative plan involves conversion of 13.3 million hectares of sensitive and carbon rich native forest land into monoculture plantations of jatropha and oil palm for biofuels. In Indonesia and Malaysia, oil palm plantations have expanded at alarming rates, pushing already threatened populations of orangutans, rhinoceros, tigers and many other indigenous animals to the brink of extinction.

Even when forested areas are not cleared directly for biofuel agriculture, forest is lost when available prime agricultural lands are used to grow biofuel crops, pushing food production into the forest frontier, causing more land to be cleared for food production. In Brazil, monopolization of prime agricultural land for sugar cane production is pushing people deeper into the Amazon to grow food.

The Rush to Develop Biofuels is Hastening the Introduction of GE and "Synthetic Biology" Schemes

Biotechnology and agribusiness industries are eager to capitalize on biofuels. Already, they are developing technologies for deriving ethanol from cellulose rich feedstocks including poplar, willow and eucalyptus. Genetic engineering is being used to develop trees that grow more rapidly, produce less lignin, or grow in poor conditions. These technologies will accelerate deforestation to clear land for monoculture plantations of genetically engineered (GE) trees. The longevity of trees and the innumerable metabolic changes they undergo during their lifespan means that controlling the expression of inserted genes is virtually impossible. Additionally, pollen models demonstrate the ability of trees to spread their pollen for thousands of kilometers (Katul, G., 2004). Cross contamination between GE trees and native forest varieties is virtually inevitable and the consequences are likely to be disastrous to forest ecosystems. Replacing native forests with monoculture plantations of genetically engineered trees would result in biological deserts devoid of wildlife.

CONCLUSIONS

The wealthy countries of the north consume a vastly disproportionate share of world's energy supplies and are most responsible for damage to the global climate. Yet developing countries in the south will likely suffer more from the effects of climate change. The rapid and heedless charge to develop markets for biofuel feedstocks will result in degradation of land and water and will contribute to the current extinction crisis. Large-scale production of biofuels must be stopped.

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COMPARATIVE ASSESSMENT OF SUBJECTIVE BENEFITS OF CLIMATE CHANGE MITIGATION BY FORESTS AND BIODIVERSITY-BASED CLIMATE CHANGE ADAPTATION MEASURES IN FORESTS IN CENTRAL EUROPE

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Keywords: choice experiment, willingsness to pay for climate change mitigation and adaptation measures, Ecosystem resilience

INTRODUCTION

The relation between forests and climate change is complex. Carbon fixation by forests mitigates CO2 –driven climate change. Climate change is supposed to have negative effects on forests, for example, by more frequent storms and pest outbreaks, or by invasive non-native species. Some of the ecological risks brought about by climate change are, yet, unknown. Biodiversity provides insurance services against these risks to the stability of forest ecosystems. We compare subjective benefits of climate change mitigation by afforestation with biodiversity-based adaption measures that insure forests against climate change-induced risks. The research area is located around Hainich forest in Thuringia (Germany).

RESEARCH METHOD

The comparative assessment of subjective benefits is implemented by a Choice experiment (CE) method. Exemplary (hypothetical) measures of climate change mitigation are expressed in the questionnaire by annual per capita carbon fixation equivalents. Exemplary (hypothetical) measures of biodiversity-based climate change adaptation are: (i) removal of potentially invasive non-native species, (ii) increasing forest ecosystem resilience in the face of storms and pests by planting habitat adapted trees currently often missing, (iii) increasing 'general' ecosystem resilience by increasing mykorrhizal species diversity.

The CE main survey (n = 302) was carefully prepared by qualitative preliminary studies (n = 16), pretest interviews (mail and Face-to-Face) (n = 57), and a pilot study (n = 100). Pilot study and main study were conducted as a househould survey by Face-to-Face interviews in 19 of the about 30 villages around Hainich National Park, and in the adjacent towns Eisenach and Bad Langensalza. To sample respondents households, we used the random route method. The interviews were conducted by five well-trained enumerators.

We estimate willingness to pay (WTP) for climate change mitigation by afforestation with insurance services of forest diversity by a Choice Experiment (CE). In the CE, mitigation and adaptation measures are represented as different attributes, and quantified by attribute levels. The quantified levels of the four insurance service attributes and the cost attribute were combined to form specific choice options printed on cardboard cards using an orthogonal main effects design. This generated 32 combinations different choice cards that were assigned to four blocks of eight choice sets. Each choice sets consists of three cards from which respondents are asked to choose the one they prefer. Each respondent was randomly allocated to one of the four blocks of choice sets. Linear utility functions additive in parameters are calculated with the Nested Logit procedures provided by NLOGIT 3.0 (Hensher et al. 2005).

RESULTS

All attributes turn out as significant determinants of choice (climate change mitigation, forest adaptation to pests and storms, general forest ecosystem resilience and cost attribute $p<0.001$, non-native species removal $p<0.05$; see Table 1). The strongest attribute-coefficient in the model is "forest adaptation to pests and storms". People are assumed to have the highest utility with the third attribute level "High resistence against pests and storms" which was presented in the questionnaire by exemplary measures of planting habitat adapted trees currently often missing. The second strongest attribute is "climate change mitigation". People preferred the third level which is expressed as "climate change mitigation by annual per capita carbon fixation equivalents (720 persons)". The third strongest attribute in the model is the "general forest ecosystem resilience". People preferred the first level "High resistence against unknown ecological threats", which was portrayed in the questionnare by exemplary measures in order to increase the diversity of tree route located mykorrhiza species The next strongest attribute is "non-native species removal", which was exemplary explained by the in germany widespreaded and as dangerous threat against biodiversity considererd plant species "Heracleum mantegazzianum".

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TABLE 1. Description of the Choice Experiment attributes and levels

Attribute (1) Climate change mitigation (2) forest adaptation measure	**Marginal[1] measure or unit (Attribute level)**	**WTP [Euro/year/person]**
(1) Climate change mitigation ***	Annual per capita carbon fixation equivalents	19,41
(2) Invasive non-native species removal**	Removal of invasive non-native species	9,46
(2) Forest ecosystem resilience in the face of pests and storms ***	Increasing/unchanging resilience by measures of planting habitat adapted trees	27,37
(2) General forest ecosystem resilience ***	Increasing/unchanging resilience by measures for increasing/unchanging mycorrhizial diversity	16,96
Cost attribute ***	Income change per month/person	

*** p≤0.001, ** p≤0.01

1. The term marginal measure or unit is used because respondents are asked to choose between alternatives from a bundle of goods in actuality and they do not choose the single attributes (units) itself in the CE. It has to be extracted in the analysis to identify the importance of the single attributes in the model.

NÉCESSITÉ DE LA MISE EN PLACE D'UNE STRATÉGIE NATIONALE DE PRÉSERVATION DE LA BIODIVERSITÉ DES PLANTES AROMATIQUES ET MÉDICINALES DU MAROC

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Mots clés : plantes aromatiques, plantes médicinales, le Maroc, dégradation du ecosystème

RESUME

Le contexte géographique du Maroc, situé entre la mer, l'océan, le désert et traversé par 3 chaînes montagneuses, se traduit par une diversité de bioclimats. Il en résulte une abondance indéniable de plantes aromatiques et médicinales qui poussent de manière spontanée.

Ces plantes constituent une richesse naturelle de première importance économique. D'autant plus que les populations marginalisées qui n'ont pas accès aux systèmes structurés de soins de santé, sont tributaires de ces médicaments traditionnels, bien connus de leur culture, abordables et généralement efficaces.

Malheureusement, on assiste la raréfaction d'importantes espèces dans des zones ou elles étaient auparavant abondantes. Si des mesures ne sont pas prises, certaines se verront menacées d'extinction. Parallèlement à la dégradation des ressources, le patrimoine culturel qui entoure l'utilisation des plantes aromatiques et médicinales peut disparaître graduellement.

A part le fléau de la sécheresse, la dégradation des écosystèmes est causée par les activités humaines tels que :

- Le développement des zones urbaines qui détruit les espaces naturels ;
- L'utilisation massive du bois en milieu rural en tant que source d'énergie et matière première pour l'élaboration du charbon destiné au milieu urbain ;
- Le surpâturage causé par le système d'élevage extensif ;
- Des cueillettes en grandes quantités avant la maturité des graines. Pour certaines plantes, se sont les racines qui sont utilisées, ce qui empêche les possibilités de régénération de l'espèce.

L'instauration d'une stratégie de préservation de la biodiversité de ces plantes à l'échelle nationale s'impose. Nous proposons plusieurs recommandations. Parmi elles :

- Développer la culture d'espèces adaptées à la sécheresse, comme aliment pour caprins, afin d'éviter la surexploitation du couvert végétal ;
- Instaurer l'électrification rurale décentralisée basée sur les énergies renouvelables, afin de limiter la surexploitation des forets;
- Accorder une attention plus soutenue aux savoirs dits traditionnels, et pallier le manque d'appui institutionnel à ces savoirs. Le pays est riche en systèmes de médecines traditionnelles par les plantes aromatiques et médicinales, qui méritent d'être étudiées scientifiquement et valorisées, en vue d'une utilisation intelligente et non mystique des possibilités thérapeutiques ;
- Elaborer des supports de formation et de vulgarisation ainsi que des langages de communication orale ou audiovisuelle, facilement assimilable par les populations rurales (majoritairement analphabètes) afin de les impliquer dans les processus de préservation de l'environnement.

ACHIEVING MULTIPLE BENEFITS THROUGH A UNFCCC MECHANISM ON REDUCING EMISSIONS FROM DEFORESTATION

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Keywords: carbon, climate change, deforestation, UNFCCC

SUMMARY

The United Nations Framework Convention on Climate Change (UNFCCC) is currently discussing the development of a mechanism for reducing emissions from deforestation in developing countries (RED). An effective RED mechanism could provide an unprecedented opportunity to contribute towards the goals of a range of multilateral environmental agreements and mechanisms, including the Convention on Biological Diversity (CBD), by helping to ensure that forests continue to provide vital ecosystem services, conserve biodiversity, and enhance livelihoods. The design and implementation of the mechanism will affect the degree to which these other benefits are obtained.

REDUCING EMISSIONS FROM DEFORESTATION

Global greenhouse gas emissions from changes in land use, including tropical deforestation are estimated to be between 18% (Stern 2006, IPCC 2007) and 25% of annual global emissions from all sources (Santilli *et al.* 2005). Discussions to consider potential mechanisms to limit this key contribution to global warming are in progress under the UNFCCC. Reducing emissions from deforestation (RED) is a distinct topic from carbon sequestration through increasing forest cover within these discussions, because the former concerns emissions and the latter, sinks. Possible mechanisms range from a fund to support individual RED projects through to a carbon-trading scheme based on national-scale accounting. Such a fund or scheme could form part of a broader "post-Kyoto" agreement on greenhouse gas emissions from 2012, with capacity building and pilot activities being proposed in the period up to 2012.

While no specific RED mechanism has yet been agreed, it is likely to focus on the reduction of emissions, measured in tonnes of CO_2, rather than of deforestation, measured in hectares of forest. As forests and other ecosystems vary in their carbon content, including that stored in biomass, soils and other compartments (FAO 2006a), there is no linear correlation between net loss of forest and the quantity of CO_2 emitted. The method of deforestation and the subsequent land use also affect the quantity of stored CO_2 that is released. Large carbon emissions can also be generated by tree removal and other degradation processes that do not cause deforestation according to current UNFCCC definitions (Mollicone *et al.* 2007). Any agreement on RED will need to specify whether such emissions are included. Other issues to be resolved include the treatment of countries whose deforestation rates are currently low, but which might be susceptible to deforestation if not involved.

OPPORTUNITIES FOR MULTIPLE BENEFITS

Many multilateral environmental agreements and processes have objectives that are directly and/or indirectly linked to maintenance of healthy forest ecosystems (Table 1). Most recognize climate change as a major factor affecting their focal concerns, and some recognize the importance of forests for carbon storage. Only UNFCCC focuses on carbon storage as an objective. Many actions being taken under these agreements and processes already limit deforestation and have the potential to contribute to RED, and many of their objectives may be supported by progress towards RED.

Within the CBD, forests are addressed in detail by the Expanded Programme of Work on Forest Biological Diversity. In addition, the indicators of progress towards the CBD 2010 biodiversity target on reducing the rate of biodiversity loss include changes in (i) the extent of ecosystems such as forests; (ii) the area of forest under sustainable management; (iii) trends in ecosystem integrity and ecosystem goods and services, and specifically in the fragmentation or connectivity of forest ecosystems. All of these indicators could be affected positively by the implementation of a RED mechanism.

The goods and ecosystem services provided by forests underpin the livelihoods of millions of people, and especially the rural poor. Careful implementation of RED could therefore help to secure and enhance the livelihoods of vulnerable people. Where forests are retained, the services they provide may also have strong influences on other ecosystems. Thus, for example, retaining forests in mountain catchments and around headwaters can not only help to ensure consistent water yields of high quality, it can contribute to the health of aquatic and wetland ecosystems and their abilities to provide ecosystem services in turn.

The actions that Parties are likely to take on RED fall into three broad categories, which are equally relevant to deforestation and degradation: (i) actions that aim to limit the drivers of deforestation, including extractive activity, infrastructure development, and agricultural expansion, as well as programmes on societal and livelihood needs; (ii) forest protected areas or community conservation areas; and (iii) sustainable forest management in production forest. Each of these actions can have multiple benefits, and decisions taken at all levels on implementation will influence the achievement and magnitude of these benefits.

It is important to recognise that efforts to reduce rates of deforestation can also be associated with risks to ecosystem services, depending on the drivers of land use change that are causing forest loss. For example, if the drivers of land use change (such as agricultural or urban development) are strong enough and are insufficiently addressed in efforts to retain forest cover, this land use change may be shifted to other ecosystems, such as wetlands or grasslands. This kind of shift might then adversely affect the goods and services provided by these ecosystems. Thus important biodiversity may be lost from these other ecosystems, water quality may be prejudiced (in the case of wetlands), or cultural values may be lost. Furthermore, the shifts may even have implications for carbon storage if the affected ecosystems have high carbon storage capacity (e.g. peatlands) and especially if the conversion process includes fire. Carefully integrated cross-sectoral planning and decision-making can help to avoid these adverse impacts.

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TABLE 1: Multilateral agreements and processes that include forest-related objectives

Instrument	Example forest-related objective(s)
United Nations Framework Convention on Climate Change (UNFCCC)	Reduction in emissions resulting from deforestation
International Tropical Timber Agreement (ITTA)	Sustainable supply of timber
United Nations Forum on Forests (UNFF)	Sustainable forest management
Convention on Biological Diversity (CBD)	Conservation and sustainable use of forest biodiversity
United Nations Convention to Combat Desertification (UNCCD)	Maintenance and restoration of forest cover as a means of reducing effects of desertification
Ramsar Convention on Wetlands of International Importance	Conservation and wise use of forest wetlands
Convention on Migratory Species (CMS)	Conservation of migratory species using forest habitats
World Heritage Convention	Protection of identified forests representing heritage of outstanding universal value
Millennium Development Goals (MDGs)	Ensuring environmental sustainability and reversing the loss of forest-related resources
Commission on Sustainable Development (CSD)	Promoting the role of forests in sustainable development
World Summit on Sustainable Development (WSSD)	Support for the forest-related components of other instruments

4

CONTRIBUTION OF BIODIVERSITY TO CLIMATE CHANGE MITIGATION

FORESTS AND CLIMATE CHANGE– MITIGATION AND ADAPTATION ACTIVITIES IN POLISH FOREST MANAGEMENT

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Keywords: forests, climate, atmosphere, biodiversity

ABSTRACT

According to the latest evaluation carried out in the frame of the Food and Agriculture Organization (FAO) Global Forest Assessment 2005, forests comprise 30% of the world's land area, they occupy more than 4 billion hectares. About 283 Giga tonnes of carbon is sequestered in their biomass, which is more than the amount of carbon stored in atmosphere. Forest management activities can contribute to climate change mitigation by three major approaches: sequestration by increasing the size of carbon pools, e.g., through afforestation; reforestation and other activities, by conservation of existing carbon pools, i.e., avoiding deforestation; as well as by substitution of fossil fuel energy by the use of biomass. All three approaches mentioned above, fit into a holistic concept of Sustainable Forest Management (SFM) and all aspects of the SFM, must be taken into account when enhancing role of forests in climate change mitigation. For this reason, reaching the goals formulated by the UNFCCC and the Kyoto Protocol should be seen in the context of forest related activities that have been undertaken in the frame of other initiatives that address a wider scope of issues, of which the most prominent are the Commission on Sustainable Development (CSD), the Convention to Combat Desertification (CCD) and the Convention on Biological Diversity (CBD).

Total forest area in Poland amounts to 9 million hectares, and the volume of growing stock reached the value of 1.9 billion cubic meters. The majority of national forests is owned by the State; share of public forests is 82%, and this circumstance creates favourable conditions for application of comprehensive policies. The acreage of newly established forests till 1990 amounted to 1.2 million hectares. Reforestation activities have been continued after 1990, following the comprehensive National Reforestation Programme, which assumes establishment of 780 thousand hectares of forest in the period 1995-2020. It is worth consideration that the National Reforestation Programme defines the standards that should be met by newly established forest, both in terms of localisation, socio-economic and environmental aspects as well as characteristics of introduced stands (e.g. species composition adjusted to site conditions). Stock utilisation is rigorously regulated thorough forest management plans that are approved at the ministerial level. Criteria applied in management plans include among others, higher cutting ages, increased shares of intermediate felling and a reduced area of clear cuts. Due to the applied measures in the period 1990-2005, a level of fellings did not exceed 52% of increment.

In the frame of the Sustainable Forest Management application context, the goals related to all aspects of sustainability should be addressed. One of these aspects is the issue of forest biodiversity. Protection of biodiversity should be see not only from a biological point of view; undertaken activities contribute also the enhancement of forest vitality - in consequence vital forests are less exposed to calamities. The examples of actions leading to conservation and protection of forest biodiversity are: naturalisation of tree species composition, introduction of under storey vegetation and enlargement of protected forest areas. The first activity is increasing tree species diversity through replacing monocultures with stands with mixed tree species composition. This activity is applied at the stand regeneration phase, in the result of these efforts the share of broadleaved species in Polish forests increased from 13% in 1945 to 24% in 2005. While the improvement of species composition could be applied for mature forests, the introduction of under-storey woody vegetation is meant for improvement of younger forests diversity. In the period of 1990 – 2005 this activity was carried out on the area of 200 thousand hectares. Additionally the introduction of under-storey vegetation has contributed

to the increase of amount of sequestered carbon. Finally, more and more of national forests are protected in a frame of one of various forms of forest protection or protectiveness. Currently, the area of protected forests amounts to 1.7 million hectares out of 9 million hectares of the total. Additionally, 3.3 million hectares are protected because of serving other protective functions. Another example is the activities undertaken by foresters in order to prevent or limit threats posed to forests by fires. In the result of introduction of complex anti-fire system, based on the advanced technologies, and which includes prevention, observation and control activities the average area of forest fire decreased from 1.6 hectare at the beginning of 1990s to 0.8 hectare at the beginning of this century.

Due to the activities described above, a net absorption of CO2, only by the above-ground wood biomass in Poland in the period 1990-2005 amounted approximately 330 million tonnes. The significance of this volume is even more visible, when it is compared with the Kyoto reduction amount assigned to Poland for the 1st Commitment Period, which is approximately 170 million tonnes in the 5 -year period. According to the latest outlooks, the trends observed in the last period could be sustained until 2020. Long-term outlooks indicate possibility of continuation of net carbon sequestration by forest ecosystems in subsequent decades. However, a condition for continuation or even further intensification of observed trends is maintenance of economic viability forest management.

Based on Polish national experiences the statement may be made, that forest management offers a significant potential to continue sequestration trends observed in the past decades, at the same time enhancing forest vitality and stability and contributing to all pillars of sustainability. When considering future forests contribution to overall carbon sequestration there is a real need for enhancement of co-operation between the climate, biodiversity and forest related initiatives and processes.

ASSESSMENT ON PEATLANDS, BIODIVERSITY AND CLIMATE CHANGE

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INTRODUCTION

Peatlands are wetland ecosystems that are characterized by the accumulation of organic matter (peat), which derives from dead and decaying plant material in water-saturated conditions. Covering only 400 million ha or about 3% of the global land area, peatlands are one of the most important natural ecosystems in the world. They are found in over 180 countries (see figure 1) and have key values for biodiversity, climate regulation and support of human welfare. Inappropriate management is leading to large scale degradation of peatlands worldwide, with major implications for climate change, biodiversity and people.

The global Assessment on Peatlands, Biodiversity and Climate Change (Parish. and Sirin, 2007) has been prepared by a multi-disciplinary international team of peatland, biodiversity and climate change specialists (under the guidance of Wetlands International and the Global Environment Centre) in the period 2005-2007 as a contribution to the global policy deliberations on biodiversity, climate change and sustainable development. It collates the best available scientific information on the nature and value of peatlands in relation to biodiversity and climate change, the impact of human activities and the potential sustainable management options. The final version of the Assessment will be circulated to the Parties to the CBD prior to CBD SBSTTA 12 meeting. Funding for the preparation of the assessment and associated activities was provided by UNEP-GEF, APN, Government of the Netherlands and Government of Canada.

The assessment was recognised by the CBD Decision VII/15 on Climate and Biodiversity which stated: "*Welcomes* the proposed assessment on peatlands, biodiversity and climate change being undertaken by Wetlands International and the Global Environment Centre with the support of UNEP-GEF, the Government of Canada, the Netherlands and others and *encourages* the involvement of parties in this assessment and in preparations for the consideration of its findings by SBSTTA prior to COP 9".

FINDINGS

Peatlands and Biodiversity

The Assessment confirms that peatlands are critical for biodiversity conservation and support specialised species and unique ecosystems and are the most efficient terrestrial ecosystem in storing carbon. Peatlands are unique and complex ecosystems of global importance for biodiversity conservation at the genetic, species and ecosystem levels. Although species diversity may be lower, the proportion of unique or characteristic species is higher in peatlands than in dryland ecosystems of the same biogeographic zone. Specialised peatland species are vulnerable to anthropogenic and climate-induced changes as they often cannot survive in other habitats. Peatlands may support biodiversity beyond their borders by maintaining hydrology and microclimate of adjacent areas and by providing habitats for migrant and nomadic species. Peatlands are often the last remaining natural areas in degraded landscapes and thus mitigate landscape fragmentation. They also support adaptation by providing habitats for species displaced by climate change.

Peatlands and Climate Regulation

Peatlands contain at least 550 Gt of carbon in their peat, which is equivalent to 30% of the Carbon in soils, 75% in the atmosphere, equal to all terrestrial biomass, and twice the carbon stock in the forest biomass of the world. Peatlands are the most efficient carbon stores of all terrestrial ecosystems. In the (sub)polar zone, they contain 3.5 times, in the boreal zone 7 times, and in the tropical zone 10 times more carbon per ha than ecosystems on mineral soil. Peatlands are the top long-term carbon store in the terrestrial biosphere and have since the last ice age played an important role in global GHG balances by sequestering an enormous amount of atmospheric CO_2. Anthropogenic disturbances (especially drainage and fires) have led to massive increases in net emissions of greenhouse gases (GHGs) from peatlands, which are now comparable to global industrial emissions. Emissions from drainage and fires in peatlands in South east Asia are estimated to be 2 billion tonnes of carbon dioxide per year or equivalent to 8% of global fossil fuel emission.

Impact of climate change on peatlands

Climate change scenarios suggest major changes in temperature, precipitation and other phenomena that will have significant impacts on peatlands, their biodiversity, carbon store and GHG flux. The balance between production and decay will alter. More frequent and extreme droughts, floods and rainstorms will likely enhance peatland erosion and desiccation and increase the incidence of peat fires. Impacts on peatlands will be regionally differentiated – such as melting of permafrost; inundation and salinisation in coastal zones or desiccation in mountain and steppe regions. The most vulnerable peatland types (tropical peat swamp forests, permafrost, steppe, mountain and coastal peatlands) require urgent adaptation measures. Climate change impacts are already visible through melting of permafrost peatlands and desertification of steppe peatlands and associated climate-induced emissions.

Integrated management and avoidance of conflicts with climate mitigation measures

The current use of peatlands is generally not sustainable and has major negative impacts on biodiversity and climate change. Integrated management of peatlands is required incorporating a range of approaches on different land use areas. Integrated management requires close coordination between different stakeholders and economic sectors and also the integration of approaches for biodiversity, climate change and land degradation.

Recommendations based on the Assessment

Key areas for future action include: Strict protection of intact peatlands is critical for the conservation of biodiversity and to maintain ecosystem functions including carbon store/sequestration; Changes in peatland management (such as better water and fire control in drained peatlands) can improve land use sustainability and reduce impacts on biodiversity and climate; Restoration of peatlands can be a cost-effective way to generate immediate benefits for biodiversity and climate change mitigation by reducing peat oxidation and fires; Developing new production techniques such as wet agriculture could generate production benefits from peatlands without negative impact to their environmental functions; Enhancing awareness and capacity, addressing poverty and inequity, and removing perverse incentives are important to address root causes of peatland degradation; Conservation, restoration and wise use of peatlands are essential and very cost effective measures for long term climate change mitigation and adaptation as well as biodiversity conservation; pilot projects to demonstrate synergistic approaches among conventions should be developed in peatlands.

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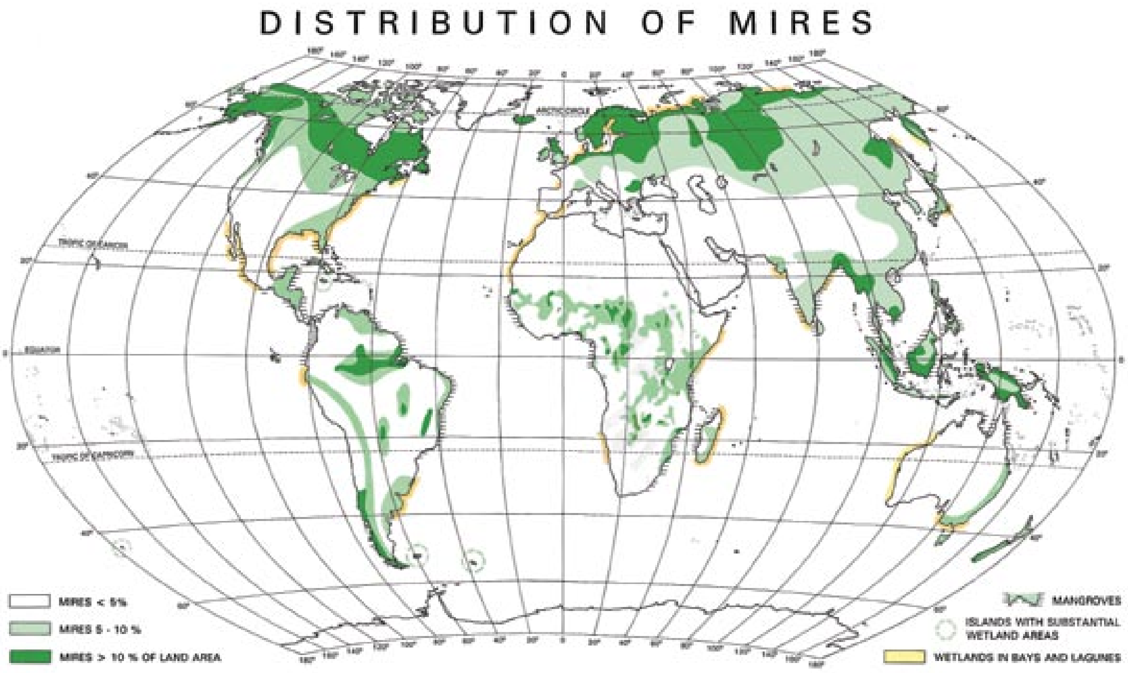
FIGURE 1. Distribution of mires/peatlands in the world



CLIMATE CHANGE ADAPTATION AND THE GLOBALLY IMPORTANT AGRICULTURAL HERITAGE SYSTEMS (GIAHS)

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Keywords: agricultural biodiversity, agricultural heritage systems, climate change, dynamic conservation, small scale traditional farmers

INTRODUCTION

Climate change is considered the most serious threats to sustainable development, with adverse impacts on the environment and natural resources (ecosystems degradation, loss of biodiversity, land degradation, etc) food security, economic activity and human well-being. While mitigation measures have traditionally been the pivotal focus for many climate change experts and scientists, adaptation to the effects of climate change and variability is now acknowledged as necessary for responding effectively and equitably to the impacts of climate change. The search for viable and sustainable solutions to address the challenges of climate change and environmental sustainability has brought into focus diverse range of approaches and development options, one of which is promoting agricultural diversification and the use of traditional agricultural practices. Many of the traditional agricultural systems by definition are adapted to their environment including adaptation to climate variabilities and change. Based on a high diversity of species and their interactions, the use of locally adapted, distinctive and often ingenious combinations of management practices and techniques, traditional agricultural systems testify to millennia of co-evolution of human societies with their natural environments. Many of these systems often reflect rich and globally unique agricultural biodiversity, within and between species but also at ecosystem and landscape level. Having been founded on ancient agricultural civilizations, these systems are linked to important centres of origin and diversity of domesticated plant and animal species, the in situ conservation of which is of great importance and global value. Among these traditional agricultural systems many are referred to as Globally Important Agricultural Heritage Systems (GIAHS) by FAO that have resulted not only in outstanding landscapes (some are recognised as world heritage sites), but, more importantly, in the perpetuation of globally significant agricultural biodiversity, maintenance of resilient ecosystems, and preservation of valuable traditional knowledge and cultural practices. Perhaps above all, they embody the principles for sustained provision of multiple goods and services, food and livelihood security, and a certain quality of life that keeps a close link with its natural environment. As described above, it is clear that GIAHS with their range of co-evolved and locally managed races, species, and agroecosystems have outstanding significance within the scope of article 8J and 10(c) of the Convention on Biological Diversity (CBD) that requires parties to "protect and encourage customary use of biological resources in accordance with traditional cultural practices that are compatible with conservation or sustainable use requirements." However, it is equally clear that the accelerating pace of change in modern political, social and economic systems and their interactions with ecological factors (which themselves are of course also changing with global climate change) pose enormous challenges for maintaining agroecosystems that are widely valued in terms of their biodiversity and cultural heritage.

GIAHS — A HERITAGE FOR THE FUTURE

Worldwide, specific agricultural systems and landscapes have been created, shaped and maintained by generations of farmers and herders have, for more than 12 thousand years, based on diverse natural resources, using locally adapted management practices. Building on local knowledge and experience, these ingenious agricultural systems reflect the evolution of humankind, the diversity of its knowledge, and its profound relationship with nature. These systems have resulted not only in outstanding landscapes, maintenance and adaptation of globally significant agricultural biodiversity, resilient ecosystems and valuable cultural inheritance, but, above all, in the sustained provision of multiple goods and services, food and livelihood security and quality of life. *GIAHS* represent a unique sub-set of agricultural systems, which exemplify customary use of globally significant agricultural biodiversity and merit to be recognised as a heritage of mankind. GIAHS are defined as: *Remarkable land use systems and landscapes which are rich in globally significant biological diversity evolving from the co-adaptation of a community with its environment and its needs and aspirations for sustainable development* (FAO 2002).

GIAHS testify to the inventiveness and ingenuity of people in their use and management of the finite resources, biodiversity and inter-species dynamics, and the physical attributes of the landscape, codified in traditional but evolving knowledge, practices and technologies (Koohafkan and Altieri 2002). Most outstanding agricultural heritage systems have evolved under particular environmental or socio-economic constraints, such as scarce water resources or frequent droughts, high altitudes, population pressures or remoteness. Examples of such agricultural systems include but not limited to: 1) outstanding terraced mountain sides with rice and complex agro-ecosystems, 2) maize and root crop based agro-ecosystems, 3) specialised dryland systems including the remarkable pastoral systems, 4) Ingenious irrigation and soil and water management systems, 5) complex multi-layered homegardens, 6) taro-based systems, and 7) hunting-gathering systems. Such agricultural systems are present in many countries and nurtures by poor farming communities. However, agricultural systems are prone to vulnerability, unsustainable practices and exploitation due to accelerating pace of climate change and its impact on biodiversity and natural habitats are already observed. Moreover, what is not being realised, once these GIAHS disappeared, their unique agricultural legacy and associated environmental and cultural local and global benefits will also be lost forever.

GIAHS — A RESERVOIR OF AGROBIODIVERSITY AND ASSOCIATED BIODIVERSITY

A growing body of scientific evidence demonstrates that indigenous and traditional agricultural systems, features a high degree of plant and genetic resources for food and agriculture. GIAHS systems often reflect rich and globally unique agricultural biodiversity, within and between species but also at ecosystem and landscape level. For instance, tropical agroecosystems composed of agricultural and fallow fields, multi-storey farming practices, complex home gardens, and agroforestry plots commonly contain well over 100 plant species per field. These biodiversity products are used for construction material, firewood, tools, medicines, livestock feed, and more importantly, for human food consumption. This is through practicing traditional agriculture, such as and multiple-cropping systems which supplies food and livelihood to about 1.4 billion subsistence families and communities. However, the continued survival of these globally important agricultural heritage systems is threatened by several factors such as the loss of customary institutions and forms of social organization that underpin management of these systems; abandonment of the traditional cultivation and farming systems; conversion of land and habitat in and around traditionally managed fields to alternative uses such as unsustainable intensive farming, plantations, housing; and the displacement and dilution of traditional varieties cultivated in these systems. These trends are leading to the erosion of GIAHS and consequently to a range of impacts on their agricultural biodiversity, associated natural ecosystems, and ecosystem functions, posing significant risks for the continued viability of unique and globally significant agricultural biodiversity and the associated knowledge and management systems that have co-evolved over numerous generations.

PROGRAMME GOAL AND INTERVENTION STRATEGY

At the occasion of World Summit on Sustainable Development (WSSD, Johannesburg, 2002), FAO developed and presented a Partnership Initiative on *conservation and adaptive management of Globally Important Agricultural Heritage Systems (GIAHS)* with the support of Global Environment Facility (GEF) and in collaboration with UNDP, UNESCO, CBD, UNU, IFAD, IUCN, Bioversity International and country partners. Please see GIAHS webpage at http://www.fao.org/sd/giahs/ for more details.

The overall programme goal is to contribute to the implementation of Article 8 J of the CBD "protect and encourage customary use of biological resources in accordance with traditional cultural practices that are compatible with conservation or sustainable use requirements", specifically within agricultural systems. The programme works on three distinct levels of intervention: *global, national* and *local or site levels*. GIAHS programme can be viewed as benchmark systems that can provide principles and lessons for national and international strategies for the in situ-conservation of biodiversity, sustainable agricultural development, climate change/variability mitigation and adaptation, and addressing the rising demand to meet food and livelihood needs of poor and remote populations. The initiative endeavour to achieve a better understanding, locally and globally, of the indigenous people's knowledge and traditional family agricultural systems and management experience related to nature and the environment, and applying this to contemporary developmental and climate change challenges, especially for the reinvigoration of sustainable agriculture and rural development. The programme also recognises fundamental importance of addressing hunger, poverty, and root causes of unmet human population needs. Thus GIAHS approach is centred on the people, human management and knowledge systems, and promotion of agricultural practices that are particularly adapted to changing climate and of the peoples' socio-organisational, economic and cultural features that underpin the conservation of GIAHS and biodiversity without compromising their resiliency, sustainability and integrity.

PRELIMINARY OUTCOMES AND THE WAY FORWARD

There is considerable diversity in the GIAHS, but they share a common attribute of functioning broadly in tune with the diversity of ecology, climate, geography, and natural resource endowments in the form of crop land, pastures, forests, fisheries, or irrigation water. Their preservation is important in a world confronted with a growing biological invasions and global climate change. Over the four years of initial phase of this programme, a call for proposals and inventory of agricultural heritage systems was launched, and some two hundred systems were identified in different parts of the world. The programme, with its innovative, integrated and holistic approach, has created awareness, interest and enthusiasm from the wider audience both from local and international bodies. More than forty systems are now identified that qualifies for GIAHS and several countries have expressed strong interest and participation in the programme. The adaptive management approach for dynamic conservation of agricultural heritage systems and in-situ conservation and maintenance of globally important agricultural biodiversity is now being piloted in seven countries representing five agricultural heritage systems, namely: 1) Chiloe agriculture in Chile; 2) Rice-fish agriculture in China; 3) Andean agriculture in Peru; 4) Ifugao rice terraces in the Philippines; and 5) oases of the Maghreb in the North Africa (Algeria, Morocco, and Tunisia). Detailed information about these systems is available at the website). The programme is expected to be implemented for a 5 to 6-year period, and ultimately, a long- term open-ended programme is envisaged that could encompass 100 to 150 Globally Important Agricultural Heritage Systems worldwide.

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BIODIVERSITY AND CLIMATE ISSUES IN THE ASEAN PEATLAND MANAGEMENT STRATEGY

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Key Words: tropical peatlands, sustainable management, biodiversity, strategy, climate

INTRODUCTION

The total area of peatlands in Southeast Asia is estimated to be about 25 million ha, which is 60% of the world's tropical peatlands and roughly one tenth of the entire extent of global peatland resource. Rich in biodiversity, the majority of the peatlands occurs in Indonesia, which has over 70% of total peatland area in Southeast Asia, Malaysia, Thailand, Viet Nam, Brunei Darussalam and the Philippines. Peatland management in Southeast Asia has reach critical cross-roads – protection versus development as land conversion and degradation caused by land and forest fires which have reduced peatland resources significantly and generating climate issues. Currently, most ASEAN Member Countries (AMCs) have recognized the need to use resources available from peatlands with a sustainable approach. This will aid in better management of the resources for current and future generations. Peatlands in AMCs provide a number of uses: agriculture, forestry, housing development, logging, extraction of non-timber forest products, water supply and storage, flood control, carbon sequestration and storage, ecotourism and biodiversity conservation. In AMCs, there are no specific laws or policies directly related to peatlands. Different aspects of peatland management are governed by a variety of different policies, laws and regulations. The ASEAN Peatland Management Strategy (APMS) is to guide AMCs to ensure effective management of it peatlands and also to enhance coordination or streamlining.

CHALLENGES IN SUSTAINABLE PEATLAND MANAGEMENT IN AMCS

AMCs faces common issues and concerns in peatland management such as common problems of fire and drainage resulting in transboundary smoke and haze, inappropriate management practices, livelihood options, sustainability, loss of essential biodiversity, concerns for climatic issues, etc. The AMCs also share similarities in many aspects such as an urgency to address and overcome common issues regarding peatland management, the following needs to be accomplished:

- Improve knowledge of peatland ecosystem [resolving issues of definitions, development of management and restoration options, research, ongoing monitoring, and sharing information]
- Resolve conflicting interests between local people, industries, government.
- Better policies and institutional frameworks.
- Demonstration sites promoting Best Management Practices (BMP) and Pilot projects to test out best management options for peatlands
- Enhance awareness and capacity building,
- Improve management of peatlands by local community groups–i.e.sustainable community livelihood through Improve partnerships between stakeholders and resolving conflicts of interests between government and non-government bodies
- Improve legislations and policies

Concerned of threats from transboundary smoke and haze from land and forest fires, mostly from peatlands ASEAN Environment Ministers in December 1997 endorsed the *ASEAN Regional Haze Action Plan (RHAP)* for strategic measures and activities to address transboundary haze pollution and on 10 June 2002 in Kuala Lumpur, Malaysia the ten AMCs signed the *ASEAN Agreement on Transboundary Haze Pollution ASEAN Agreement on Transboundary Haze* which entered into force on 25 November 2003. *ASEAN Peatland Management Initiative (APMI)* was developed and endorsed at the 10th ASEAN Ministers Meeting on Haze (AMMH) in March 2003, Cambodia.

Many efforts and actions toward conservation and management of peatlands in the region have been country-based and stand-alone activities. Collaborative efforts under ASEAN cooperation arrangements were limited but did not include a long-term strategy specifically to address the issues of peatlands in the region. The APMI provides the framework for peatland management in the region. Practical and meaningful strategies are required. The ASEAN Peatland Management Strategy (APMS) would guide countries into taking actions that would ensure improved management of its peatlands.

The goal of the APMS is "*To promote sustainable management of peatlands in the ASEAN region through collective actions and enhanced cooperation to support and sustain local livelihoods, reduce risk of fire and associated haze and contribute to global environmental management.* The regional strategy will provide a common framework for all those with responsibilities for, or commitments to, the wise use and sustainable management of peatlands, prevention of fires, rehabilitation and the conservation of essential biodiversity. It builds on the principles for regional cooperation embodied in the Declaration of ASEAN Concord II (Bali Concord II). The strategy will be a contribution to the implementation of the ASEAN Agreement on Transboundary Haze Pollution and the ASEAN Regional Haze Action Plan

The APMS has 4 General Objectives and 13 Operational Objectives. Each General Objective is to be delivered by the Operational Objectives and Actions that are grouped in thirteen different focal areas. An action plan for the strategy is needed to operationalise the implementation of the strategy. Specific action points are assigned for each Operational objective to be implemented at different levels and timescales. AMCs will develop their respective National Action Plans (NAPs) for the period of 2006-2020.

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INTACT FOREST LANDSCAPES — PROTECTING CARBON AND BIODIVERSITY

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INTRODUCTION

Forests are invaluable as a treasure trove of biodiversity, containing an estimated two-thirds of the world's terrestrial species. Forests are also invaluable for the ecosystem services they provide: food, water regulation and filtration, rainfall regulation. One particular ecosystem service, carbon storage, has been increasingly recognised as important recently. Intact forests act as a brake on further acceleration of climate change by serving as a vast carbon reserve. Fragmentation of these forests and selective logging cause carbon losses and degrade the forest, leaving it vulnerable to further degradation and climatic changes. Using the example of the Democratic Republic of Congo (DRC), we demonstrate that these losses of carbon are significant and that there is an urgent need to protect Intact Forest Landscapes (IFL), not only for their biodiversity, but also for their carbon stocks.

FRAGMENTATION AND DEGRADATION CAUSED BY SELECTIVE LOGGING RESULT IN CARBON EMISSIONS

It is not only the direct effects of deforestation that causes losses of forest carbon to the atmosphere: indirect effects are also important. When forests are completely cleared – for instance, to make way for agriculture plantations or grazing – up to half the carbon they held may be emitted into the atmosphere (Houghton, 2005). Even selective logging, as generally practised in the DRC and elsewhere in Central Africa, can have a serious carbon impact.

Roads built for selective logging cause deforestation. But the roads also cause fragmentation of intact forest landscapes. Trees on the edges of such fragments are vulnerable to drought, wind and fire (Laurance, 2005), all of which can result in death and the release of stored carbon. In addition, roads can precipitate further logging, leading to complete deforestation.

Selective logging also causes damage to surrounding trees, which can be significant. Only a small fraction of cut wood ends up stored in houses or other long-lasting structures which store carbon; the majority of carbon is lost to the atmosphere though the decay or burning of waste (Houghton 2005). It has been estimated for the Republic of the Congo, adjacent to the DRC, that 0.46 tonnes of carbon are emitted per cubic metre of timber extracted (Brown et al. 2005). The combined indirect effects of selective logging (roads, fragmentation and incidental damage) are highly important as the direct impacts, both in terms of biodiversity and carbon.

Using satellite data, Greenpeace has conservatively predicted the overall carbon emissions from an area of the DRC that has been selectively logged. The potential emissions from forest fragmentation as a result of this infrastructure were nearly 2.5 times greater than, and in addition to, those created by actually extracting the commercial logs. This suggests a significant impact when scaled up across the whole of DRC. Similar losses can be expected in other tropical forests.

INTACT FOREST LANDSCAPES SHOULD BE PROTECTED

At present, the global figures used by the Intergovernmental Panel on Climate Change (IPCC) and United Nations Framework Convention on Climate Change (UNFCCC) exclude emissions resulting from the fragmentation of vast areas of intact forests into smaller areas – for example by logging roads (see, e.g. IPCC, 2000). However, as these calculations show, these indirect effects are even more important that the timber actually removed. Therefore, they should be included in estimates of carbon lost from land-use change calculations. In particular, these indirect effects should also be considered in light of the discussions on Reducing Emissions from Deforestation in Developing Countries within UNFCCC.

Greenpeace has recently published maps of Intact Forest Landscapes of the world (www.intactforests.org). Less than one fourth of the forest zone of the Earth forest zone remains as Intact Forest Landscapes. That is only 8.8% of the Earth's land surface. Only fourteen countries, including Canada, Brazil, Russia, Papua New Guinea, Democratic Republic of the Congo, and Indonesia control 92% of the world's remaining Intact Forest Landscapes. However, overall, only 7.9% of all Intact Forest Landscapes lie in strictly protected areas (IUCN categories I - III). Conservation of Intact Forest Landscapes is a robust and cost-effective way to conserve biological diversity and carbon. The remoteness and large size of these areas provide the best guarantee of continued intactness, secure carbon stocks and resilience to climate change.

CONCLUSION

Selective logging causes significant carbon losses 2.5 times greater than, and in addition to, those created by actually extracting the commercial logs in the DRC. Similar results can be expected from other tropical forests. These losses of carbon need to be included in estimates of carbon lost from land-use change calculations. Protection of Intact Forest Landscapes from logging, including selective logging is the best method to conserve biodiversity, secure carbon stocks and increase adaptability and resilience of forest ecosystems to climate change.

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