European biodiversity research for a sustainable Europe:

Research contributing to the implementation of the EU Biodiversity Strategy

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Front cover: "Scottish landscape" by Lady Catherine Young.

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Preface

Research on biodiversity is essential to help the European Union and EU Member States to implement the Convention on Biological Diversity as well as reach the target of halting the loss of biodiversity in Europe by 2010.

The need for co-ordination between researchers, the policy-makers that need research results and the organisations that fund research is reflected in the aims of the "European Platform for Biodiversity Research Strategy" (EPBRS), a forum of scientists and policy makers representing the EU countries, whose aims are to promote discussion of EU biodiversity research strategies and priorities, exchange of information on national biodiversity activities and the dissemination of current best practices and information regarding the scientific understanding of biodiversity conservation.

This is a report of the E-Conference entitled "European research for a sustainable Europe: Research contributing to the implementation of the EU Biodiversity Strategy" preceding the EPBRS meeting to be held under the German EU presidency in Leipzig, Germany, from the 5th to the 7th May 2007.

Introduction

Carsten Neßhöver

Having "the sustainable use of biodiversity" as the overarching topic of an e-conference and a forthcoming EPBRS-meeting appears, at first sight, to be too broad. However, combining the conservation of biodiversity with its sustainable use is the only way forward to a sustainable future:

- The new IPCC reports outlines the danger of accelerated climate change for human well being and ecosystems,
- The Millennium Ecosystem Assessment has shown that most ecosystem services are already heavily under pressure by human use,
- The FAO has just released a report stating that continued increase in cattle production in the next decades would strongly influence the very basics of the world's food supply and the health of its ecosystems.

Thus, dealing with the sustainable use of biodiversity in the context of different systems is essential for safeguarding human well being in the future. Furthermore, by dealing with sustainable use, the basis of the work of EPBRS comes to the fore of discussions: linking biodiversity research with the main problems and questions that arise in policy and society on biodiversity. The main document in this context for Europe is the EC's communication on "Halting the biodiversity loss until 2010 and beyond", published in May 2006 (COM (2006) 216).

The e-conference and EPBRS meeting focus on three main objectives within this communication:

- Session I: Research contributing to reaching the 2010 target in the wider countryside (objectives 2 and 4 of COM).

It is well known and accepted that the loss of biodiversity can only be halted if the strong pressure on it resulting from intensive land use and management practises are designed in a more sustainable way. A multitude of measures have been developed and implemented in order to approach this goal. But successes still appear to be small, due to diverse constraints. On the other hand, new pressures are emerging: e.g., increased biofuel production and climate change may strongly alter land use management within the next years and decades and, currently, integrated management strategies dealing with such dynamics and uncertainties are rarely in place. Session I will deal with such diverse issues, trying to identify the most pressing questions to be tackled by research. The session was chaired by Klaus Henle (UFZ).

- Session II: European biodiversity research and the global perspective (objectives 6, 7 and 8 of COM).

The EC's communication also strongly emphasizes the role of the EC in the conservation and use of global biodiversity. European funded biodiversity research across the globe has a long tradition but, nevertheless, has to ask itself under increasing pressures if it is still asking the right questions and how its work can be linked more properly with research and policy in the host countries of their work. Session II will deal with this question, based on a former E-conference by the ERA-NET Biodiversa (www.eurobiodiversa.org). The Session was chaired by Jacques Weber (IFB) and Gerry Lawson (RCUK).

- Session III: Biodiversity and ecosystem services: the Millennium Ecosystem Assessment concept from a European perspective.

The concept of ecosystem services and human well being, as developed by the Millennium Ecosystem Assessment framework, is having a strong impact on environmental policy formulation and reasoning for safeguarding biodiversity. Nevertheless, in a European context, the concept needs to consider the long history of environmental policy and landscape management in Europe. Thus, determining those aspects of the concept that are useful in the European context is crucial. Session III, chaired by Kurt Jax and Carsten Neßhöver (UFZ) addressed this aspect.

We hope that these topics will cover important aspects of the sustainable use debate and will lead to fruitful debates during the forthcoming EPBRS meeting.

Summary of contributions

Juliette Young and Allan Watt

Session I: Research contributing to reaching the 2010 target in the wider countryside

The topics explored in this first session can broadly be summarised under three main headings:
1. Status and trends of biodiversity in the wider countryside;
2. Drivers of change in the wider countryside; and,
3. The management of biodiversity in the wider countryside.

In terms of assessing status, changes and trends in model components of biological diversity in the wider countryside, Jan Plesnik, like many participants in session II, emphasised the need for a reasonable monitoring scheme based on the agreed baselines and standards at the European level as well as an accessible Europe-wide geo-referenced inventory of species, ecological/functional groups and habitats to better understand and assess their distribution status, changes and trends. Building on his experiences with the "Countryside Quality Counts" project, Roy Haines-Young emphasised the need for monitoring of changes in the wider countryside to take account of stakeholder values and visions. The classification of habitats was addressed specifically by Mauro Agnoletti who expressed concerns over the FAO classification of EU forest origins and possible repercussions of this classification for the selection of Natura 2000 sites. Still on the topic of forest biodiversity, Petr Petøík emphasised the need to compile a comprehensive methodology for monitoring changes in forest species diversity in order to integrate various systems of monitoring schemes for the evaluation of forest ecosystem conditions and to integrate new methods of evaluation of the carrying capacity and vulnerability of forest ecosystems in land-use planning and to develop further studies on the evaluation of mechanisms and sources of biodiversity changes on genetic, species, population, ecosystem, and landscape levels. Related to this last issue, Teja Tscharnke discussed the importance of the landscape perspective in understanding patterns in functional biodiversity and the relation of biodiversity to ecosystem services and called for more research on the relative importance of local and landscape management for biodiversity and its relation to ecosystem services such as pollination. Ernst-August Nuppenau also stressed the need to better understand the value of a diverse environment, as well as

the contribution of biodiversity to production and income in order to find answers to how farmers can be integrated into biodiversity conservation. The need to better understand the interactions of human behaviour and ecosystems was also highlighted in Silvia Wissel and Florian Hartig's contribution. In a similar vein, Klaus Henle stressed the need for more research on biodiversity conservation in the wider (European) countryside by natural resource management complemented by research that develops strategies on how the conservation of biodiversity can contribute to the cultural, social, and general well being of the people living in and of the wider countryside.

A number of contribution addressed particular threats to biodiversity in the wider countryside and possible research needs to counter these. A threat mentioned by many participants was that of land abandonment. Herbert Prins focussed in his contribution on the effects on biodiversity of shrinking human populations in the wider countryside and suggested a number of areas of research including mapping new wilderness and better understanding the demographic patterns concerning human population decline and land abandonment. In terms of the growth of wild large animal populations in new wilderness areas resulting from abandonment, he suggested research on the ecological requirements, population dynamics and possible economic and financial possibilities of sustainably harvesting rebounding wildlife, as well as the effects of such harvesting. Jan Jansen described the history of heathland-based farming systems in Western Europe and illustrated their potential role in providing local food, maintaining an attractive open landscape, contributing to the Natura 2000 network and halting the loss of biodiversity both in nature areas and the adjacent wider countryside. In order to develop heathland-based farming systems, however, he emphasised the need for economic possibilities of farming to be re-examined, particularly in remote areas where traditional farming is still being practiced, but also the economic possibilities of reintroducing heathland-based farming close to densely populated areas. Following a contribution from Richard Hardwick, Jan Jansen expanded on his earlier contribution by specifying that research on the economic possibilities of heathland-based systems should include additional functions of farming including contributions to nature conservation, water management etc. Closely related to this topic, Yvonne Cerqueira wrote about the impacts of land abandonment on biodiversity and the loss of Traditional Ecological Knowledge (TEK). She called for more documentation of such knowledge, as well as research incorporating TEK into adaptive co-management practices. Related to the shift in population from rural to urban areas, Jukka Jokimäki called for more research on the likely areas affected by urban sprawl (including tourist destinations), and the effects of urbanisation on biodiversity.

In addition to land abandonment, other threats including climate change, biofuel production, the implementation of new policies in the New Member States and illegal poisoning. Angheluta Vadineanu stressed the need for research on describing the complex links between biodiversity, climate change and socio-economics across spatial and temporal scales. In relation to biofuel production, Giselher Kaule suggested research on the impact of the new forest matrix on biodiversity and the "design" of the habitat network, which could mitigate this development. He also emphasised the need for monitoring programmes and a renaissance of field studies. Jan Jansen endorsed this need for more field studies in Session III. In view of sudden changes in the New Member States, Tiiu Kull suggested research on the impact of different spatial schemes and management techniques of different energy crops on biodiversity, research on the possibilities of

regulating the spatial planning principles and research to help formulate the necessary conditions for an agricultural management of landscape that would increase biodiversity without introducing alien species (e.g. organic farming). Another threat, highlighted by Sergio Couto and his colleagues was that of illegal poisoning of raptors and carnivores in the wider countryside. Despite local efforts and successes to coordinate and promote actions against these practices, the authors call for more research on the impacts of such practices on wildlife, research on measures to counteract this practice and the social perceptions of illegal poisoning. They also called for EU-wide coordination and dissemination of research results, as well as best practice guidelines.

A number of other contributions focussed on particular species and habitats. Discussing the issue of forest biodiversity, Tor-Björn Larsson highlighted the fact that although progress was being made to halt biodiversity loss in European forests, many types of forests were still under threat and this required additional research on identifying cost-effective and realistic ways to stop biodiversity loss in these types of forests. The loss of genetic diversity of crop varieties, livestock breeds and races was highlighted in Allan Watt's contribution, in which he identified a major research priority as being the quantification of trends in the genetic diversity of harvested and domesticated species and the identification of policies and practices that ensure long-term sustainable use. On the same topic, Brian Ford-Lloyd suggested research testing whether the numbers of distinct land races could be a good proxy indicator of genetic diversity of crops. Addressing the issue of the sustainable use of fish, Dave Carss presented some of the results of the INTERCAFE project and suggested research on how "conservation success" species needs to be best managed at the continental scale where their impacts on other species of conservation concern are apparent; research on what affects the distribution and community structure of fish; and research to help identify policies and practices that ensure the conservation of fish species, the restoration of more natural fish community structures, and their long-term sustainable use. Finally, Allan Watt called for more research on soil diversity, specifically developing standardised approaches to monitoring soil biodiversity, quantifying the impacts of the major pressures on soil biodiversity and establishing ways of alleviating these pressures. This view was shared by Carlo Jacomini, who highlighted that a wider approach to the issue might be sought through the EU Directive on soil protection.

A number of authors focussed their contribution on the management of biodiversity in the wider countryside. David Pimentel for example commented on possible ways forward in conserving the wider countryside and advocated the encouragement and implementation of ecologically sound and sustainable management practices for agriculture and forestry. Contributors addressed both existing policies and possible new measures to conserve biodiversity in the wider countryside.

On the topic of agri-environment schemes (AES), David Kleijn highlighted the need for ecological information on the impacts of schemes on land abandonment and the associated biodiversity implications. Although he acknowledged that there was sufficient ecological insight and geographical information to identify the objectives, outcomes and targeting for potential AES prescriptions, ecological insights were often lacking for spatial scale effects and for temporal and ecosystem service effects. Building on his suggestion of linking wide-scale ecological evaluations to specific case studies on the causes of effectiveness of lack thereof, Jan Jansen suggested these could, in some cases, reveal specific situations that deserved

subsidies. Still on the topic of agri-environment schemes, Frank Wätzold highlighted three main areas where research was needed to improve the cost-effectiveness of such schemes, namely the development of decision support tools for designing cost-effective agri-environmental schemes, comparative research identifying best practice, and research to investigate how institutions and governance structures have to be designed to ensure that the available money is spent in the interest of conservation.

Cross sectoral integration of biodiversity was the topic of Rainer Müssner's contribution, which stressed the need to enhance scientific methods to evaluate the relative success of integration of biodiversity concerns in sectoral strategies and implementation plans and measures; to develop feasible indicators to measure and evaluate the level of integration of biodiversity concerns in sectoral policies, strategies and operational plans; and finally to carry out research on how to enhance the effectiveness and efficiency of SEAs and EIAs.

Silvia Wissel and Florian Hartig stressed the need for integrated research between social and natural sciences to better understand the impacts of different policies, a point also made by Angheluta Vadineanu who stressed the need for research of this type to be carried out at regional, national and European scales

Discussing the design of sustainable landscapes, Dirk Wascher highlighted three main areas of research, namely research on the development of indicators of sustainable development that can be made operational in a context of trans-disciplinary research and bottom-up dynamics, research on the application of landscape planning tools that build on the concepts of dynamic sustainable development, introducing the concept of resilience to both environmental and social systems and finally research to incorporate these concepts in visions of 'ontogenetic integrity' of landscapes to be understandable for all stakeholders (from local to national level). Focussing his contribution on differences between the resilience of cultural and natural landscapes, Jan Jansen queried Dirk Wascher's claim of reaching sustainable landscapes, particularly in light of present global changes. Although Dirk Wascher believed this was indeed possible, he did however highlight that the challenge would lie in establishing decentralized dynamic market systems where economic profit is re-invested into regional sustainable goals, monitored and if necessary co-subsidized on the basis of European indicators and priorities. Still on the same topic, Alessandro Gimona came up with a number of research needs, including the need to identify landscape areas that can deliver multiple benefits (including biodiversity) from various stakeholder points of view and ways to find sound ways to incorporate stakeholder's views in the planning process. Another related research need highlighted in this contribution was the design of economic tools and incentives for farmers and land owners that take account of the relevant social factors. Finally he also called for the effect of scale on the planning process to be considered.

Possible new measures to reach the 2010 target in the wider countryside were suggested by participants, including Tradable Permits, described in Silvia Wissel and Florian Hartig's contribution. They called for more research on the Tradable Permits market to determine their potential in providing an effective policy tool for the sustainable use of landscapes. Markus Groth presented results of two plant auctions in Lower Saxony and called for more research on plant biodiversity auctions as a possible new tool in the EU's agri-environment policy.

Speaking from a policy-maker's point of view, Andrew Stott highlighted research focussing on baseline information on status and trends in biodiversity in the wider countryside, the development of methods and tools for formulating biodiversity policy and targets, recognising the dynamic global economic and environmental

situation; improving decision methods including cost/benefit analysis, risk assessment and participatory processes, monitoring and evaluating the outcomes and impacts of policies at national, regional and global levels to assess progress towards 2010 targets.

Session II: European biodiversity research and the global perspective

The introduction to session II sparked off a lively debate among participants, including a contribution by Wouter Los in which he suggested categorizing the different suggested topics in a few research domains which are relevant to be addressed at global scale, and which can be used to structure this summary section:
1. Knowledge about the relevant components of biodiversity (taxa, distributions, trends)
2. Biodiversity functions, changes and adaptive capacity
3. (Technological, societal and political) management of biodiversity (EU and CBD programmes)
4. Interactions with other policy domains (trade, food, health, combating poverty, biotechnology)

The first issue dominated the second and third weeks of this session. Norbert Jurgens, Christoph Knogge and Karl Wantzen all highlighted the need for the development and availability of inventories and assessments of present diversity. Julia Jones focussed exclusively on the topic of monitoring in her contribution, warning about the potential dangers of monitoring and indicators and advocated the use of targeted monitoring in conservation monitoring. In response to her contribution, Allan Watt called for intensive research on selected species and ecosystems to provide the basis for more informative monitoring and more effective interventions. Reflecting on his experiences of monitoring in Russia, Vladimir Vershinin acknowledged the impossibility of an "absolute" method to monitoring and suggested instead an approach combining complexity and long-term observation in ecological monitoring. In reply to Jan Jansen's call for a common agreement on the monitoring of biodiversity, Allan Watt mentioned the efforts already in place to come to such an agreement, and suggested that researchers could help by agreeing protocols for the monitoring of biodiversity. In terms of specific methods for monitoring that could be used for such a standardised approach, Alan Feest highlighted two validated biodiversity measurement methodologies (butterfly walk method and common bird census) and suggested one area of research could be to test these methods for high biodiversity habitats. In response to this contribution, Jorge Soberon expressed doubts on the application of such methods in high-diversity areas such as Brazil or Peru and suggested high-tech methods, like sound recognition, for birds, certain bats, certain frogs and certain insects or developing monitoring schemes for lay people and developing statistical methods capable of dealing with such non-standard sampling. Jan Jansen and Frédéric Archaux et al. addressed the potential application of the walk method (and other approaches) for monitoring vegetation. The latter argued for optimisation, standardisation and calibration to successfully monitor temporal changes in plant richness as well as "averaged" indices over the community to reduce biases and help reveal mechanisms. Acknowledging the huge amounts of monitoring taking place already, Klaus Henle suggested that the EU should develop a system on how the information and the databases generated through research projects could be maintained and updated in the longer run. This approach was seconded by Vladimir Vershinin's contribution on this topic. Taxonomy was also widely discussed in this session. Wolfgang Wägele started the discussion with a call for technologies and

databases that speed up (a) access to taxonomic and biogeographic data; (b) re-identification of already known species; (c) description of new species; (d) re-identification of yet unnamed species; (e) quantitative assessment of species diversity. Agreeing on many of the points made by Wolfgang Wägele regarding the taxonomic impediment to activities in biodiversity research, Chris Lyal suggested a number of measures to address this impediment, including increased funding, clarity regarding the needs of the users of taxonomy, digitised access to data and effective project design.

Regarding the second point, i.e. research on biodiversity functions, changes and adaptive capacity, Norbert Jürgens highlighted a number of gaps in knowledge, including monitoring and assessment of the change of biodiversity in different biomes, integrating analyses of the potential drivers of change, and understanding of the processes and mechanisms which govern change of biodiversity. He also stressed the need for analysis of the consequences of changing biodiversity for ecosystem functions and for services to local, national and continental economies and society, integrating the economic equivalent of these changes. Christoph Knogge and Karl Wantzen suggested developing tools for modelling future scenarios for management and preventive land use planning, management of biodiversity on the regional scale, management and development of techniques of land use systems and use of natural resources. In terms of biodiversity functions, Felix Rauschmayer added a number of questions to consider in this session, including the question of how to account for ecosystem services in other parts of the world when doing sub-global Millennium Ecosystem Assessment (MEA)-like assessments.

In terms of the management of biodiversity, Norbert Jürgens specifically emphasized the need to develop science-based strategies and tools for sustainable management and conservation of genes, species and ecosystems, as well as socio-economic and policy concepts for a realistic and feasible transformation from present exploitation practices to sustainable land and resource use regimes and governance patterns. Susanne Stoll-Kleemann described her work carried out in the GoBi (Governance and Biodiversity) project and stressed the need to gather more (meta) data on the level of protected areas and biosphere reserves which is open to all researchers who want to work with it in order to be able to measure the success of conservation measures. In addition she emphasised the requirement for more research conducted by interdisciplinary teams and on the basis of the ongoing participation of all relevant stakeholders. This was also a point made by Norbert Jürgens, who stressed the need for communication and learning partnerships with resource users and other stakeholders at the levels of households, farms, villages, nations and regions.

A recurrent theme throughout the session was the need for building of national capacities (see contributions from Jorge Soberon's, Christoph Knogge and Karl Wantzen). Jurgen Tack addressed this theme in more detail in his contribution, in which he suggested a number of ways to promote better capacity building in biodiversity research. These included the need to specify capacity building as a target, define capacity building and what can be expected from it, describe the process towards capacity building and specified outcomes. Finally, he emphasised the need to ensure that projects initially funded with a target of capacity building were not subsequently treated as pilot projects and refunded on a recurrent basis.

On the last point, Ashish Kothari wrote a particularly interesting contribution addressing the issue from a different perspective and suggested research on the impacts of Europe on the biodiversity of southern countries, namely the consumption

of goods and services from the south (including primary products, services such as tourism), and the impacts of development assistance.

Session III: Biodiversity and ecosystem services: the Millennium Ecosystem Approach concept from a European perspective

Martin Sharman stimulated a number of responses with his contribution, in which he foresaw a number of issues that might be recommended by SBSTTA and possible questions arising from these.

In reference to Martin Sharman's first question on MEA-like assessments, Felix Rauschmayer responded by calling for more cooperation between natural and social scientists in the design and coordination of MEA-like assessment and the integration of policy-makers in the design and implementation of the research. This was reinforced by Mirilia Bonnes' contribution. Ferdinando Boero also approved of the idea of carrying out MEA-like assessments but called for more discussion on the meaning attributed to "ecosystem". This point was explored in Marion Potschin and Roy Haines-Young's contribution where the authors considered different spatial frameworks and suggested that a landscape focus might be more appropriate.

In terms of the global standards in data collection and integration, Felix Rauschmayer argued that establishing global standards might threaten the strengths of the MEA assessments by loosing policy-relevance as well as interdisciplinary integration between natural and social scientists. Regional standards may be a better option in homogenous regions. Ferdinando Boero called for standards on what data need to be collected and how this data should be stored. In addition, Petr Petøík added the need for standards to determine how to analyse data.

In terms of access to public-good research results on biodiversity, all contributors approved of the public use of such results.

Finally, regarding the communication of results, Felix Rauschmayer suggested that communication be made integral to research and suggested the integration of policy-makers in the design phase of research. In addition he suggested employing communication professionals to improve communication efforts. Finally he called for more meta-research on science/policy interfaces. Still on the issue of communication, Ferdinando Boero presented an example in Italy, where the ministry of the environment is using funds to support TV programmes in which aspects of biodiversity research are presented to the wider public.

Andrew Stott added to Martin Sharman's list by asking how far proposals for MEA-like assessments meet the needs identified by the IMoSEB consultation process. Carsten Neßhöver responded in the context of possible sub-global assessments for Europe. Still in relation to this topic, Thomas Koetz stressed "the importance of being more critical in the way needs were defined and to keep the overall objective of such mechanisms/processes/assessments in mind, before assessing whether such exercise would fill the needs raised by the IMoSEB consultative process".

Looking in more detail at the ecosystem services approach as a tool, Martin Sykes highlighted the difficulties inherent in quantifying ecosystem services and the lack of knowledge on the real effects of loss of some of these services for ecosystems and humanity. He concluded that addressing the challenge of quantifying ecosystems services involved "carefully selected cases at the right scale, combining experiments, data and models, within an integrated approach around the relevant science and socio-economics at scales that are determined by policy requirements, rather than by the scientists". On the topic of scale, Christoph Görg emphasised the need for multi-scale

assessments including both horizontal and vertical scale interactions. Gary Luck and Richard Harrington focussed on the quantitative links between biodiversity and ecosystem services and described the approach of using "Service Providing Units" (SPUs) in the Rubicode project. Elena Bukvareva backed the SPU approach in biodiversity research (for example the valuation of boreal ecosystems), as well as more practical aspects of biodiversity conservation.

In terms of the valuation of ecosystem services, Clive Spash called for research into methods of expressing and articulating plural and multiple values and designing institutions that are able to protect and nurture them. Ferdinando Boero endorsed this view. In relation to this, Paula Harrison, Pam Berry, Gary Luck and Richard Harrington all mentioned the need to develop appropriate valuation techniques enabling costs of changes in ecosystem services to be calculated. Building on his experience of valuation of ecosystem services in the Baltic Sea, Jan Marcin Weslawski emphasised the need for valuation exercises to include more research on the view and opinions of local people. Still on the topic of valuation, Elena Bukvareva suggested a damage-based approach to valuation, i.e. the calculation of real and potential damage as a result of biodiversity degradation or loss.

Alison Holt suggested a number of other research needs, including the need to better understand the relationship between biodiversity and ecosystem services, and to collate suitable data across the natural and social sciences to assess the sustainability of ecosystem service provision and consumption. In relation to the first point, Nicola Beaumont and Melanie Austen recognised the need to better understanding the contribution of biodiversity to services such as resilience and resistance and nutrient cycling. On this point, Richard Harrington mentioned the development, within the Rubicode project, of 'a service-led approach to understanding the link between services, functions and different components of biodiversity (e.g. functional groups...)'.

Another challenge in using ecosystem services as a tool was highlighted by Marion Potschin and Roy Haines-Young, who stressed the difficulty in determining what an ecosystem is. Moving away from the 'habitat' unit, they presented a more explicit 'service' approach and called for more research on defining the 'relevant ecosystem service unit' from both the 'supply' and 'demand' side. In order to achieve the above research, most participants to the e-conference stressed the need for interdisciplinarity between natural and social scientists, as well as the involvement of other stakeholders. Paul Armsworth focussed specifically on this aspect in his contribution, in which he discussed the individual and institutional changes required for such an approach. This was also the topic of Josef Settele's contribution, which concentrated on the potential of large-scale integrative projects (such as Networks of Excellence) to meet many of the challenges of MEA-like approaches.

Research priorities

Juliette Young, Allan Watt, Carsten Neßhöver, Klaus Henle, Kurt Jax, Gerry Lawson and Jacques Weber

Session I: Research contributing to reaching the 2010 target in the wider countryside

1. Status and trends of biodiversity in the wider countryside:

- Developing a monitoring schemes for biodiversity (including soil biodiversity) based on agreed baselines and standards at the European level;
- Developing an accessible Europe-wide geo-referenced inventory of species, ecological/functional groups and habitats;
- Developing a better understanding of the relationship between biological diversity and ecosystem functioning;
- Determining the relative importance of local and landscape management for biodiversity and its relation to ecosystem services such as pollination;
- Understanding the value of a diverse environment and its contribution to production and income in order to find answers to how farmers can be integrated into biodiversity conservation;
- Identifying carrying capacity thresholds and patterns in main ecosystem types;
- Understanding biological/ecological integrity concepts;
- Developing widely acceptable classifications for habitat/ecosystem/land-use/landscape types;
- Monitoring changes in the wider countryside to take account of stakeholder values and visions;
- Mapping new wilderness areas resulting from land abandonment;
- Developing indicators of sustainable development that can be made operational in a context of trans-disciplinary research and bottom-up dynamics.

2. Drivers of change in the wider countryside:

- Analysing biodiversity changes, drivers and pressures taking into account the synergistic effect of various anthropogenic and natural drivers of biodiversity change;

- Understanding the interactions between human behaviour and ecosystems in the wider countryside;
- Understanding the demographic patterns concerning human population decline and land abandonment;
- Determining the ecological dynamics, impact and economic and financial potential of sustainably harvesting rebounding wildlife;
- -Re-examining the economic possibilities of farming, particularly in remote areas where traditional farming is still being practiced, but also the economic potential of reintroducing farming close to densely populated areas;
- Identifying the opportunities and costs of biofuel production on biodiversity;
- Research into traditional ecological knowledge (TEK) and how to integrate it into research and conservation initiatives;
- Determining the likely areas affected by urban sprawl (including tourist destinations) and the effects of urbanisation on biodiversity;
- Determining the impacts and social perceptions of illegal poisoning on wildlife;
- Determining the impacts affecting the distribution and community structure of fish;
- Quantifying the impacts of the major pressures on soil biodiversity;
- Describing the complex links between biodiversity, climate change and socio-economics across spatial and temporal scales;
- Determining the impacts of agri-environment schemes on land abandonment and the associated biodiversity implications.

3. The management of biodiversity in the wider countryside:

- Evaluate the relative success of integration of biodiversity concerns in sectoral strategies / implementation plans and measures;
- Develop feasible indicators to measure and evaluate the level of integration of biodiversity concerns in sectoral policies, strategies and operational plans;
- Conduct research on how to enhance the effectiveness and efficiency of SEA and EIAs;
- Assess the impacts of current forestry policy and management on biodiversity;
- Understanding the Tradable Permits market to determine whether it can provide an effective policy tool for the sustainable use of landscapes;
- Understanding the impacts of different policies on biodiversity;
- Developing decision support tools for designing cost-effective agri-environmental schemes;
- Investigating how institutions and governance structures have to be designed to ensure that the available money is spent in the interest of conservation;
- Developing landscape planning tools that build on the concepts of dynamic sustainable development, introducing the concept of resilience to both environmental and social systems;
- Identifying landscape areas that can deliver multiple benefits (including biodiversity) from various stakeholder points of view and ways to find sound ways to incorporate stakeholders' views in the planning process;
- Designing economic tools and incentives for farmers land owners that take account of the relevant social factors;
- Quantifying trends in the genetic diversity of harvested and domesticated species and identify policies and practices that ensure their long-term sustainable use;

- Developing research to help identify policies and practices that ensure the conservation of fish species, the restoration of more natural fish community structures, and their long-term sustainable use.

Session II: European biodiversity research and the global perspective

1. Knowledge about the relevant components of biodiversity (taxa, distributions, trends):

- Developing and disseminating inventories and assessments of present diversity – taking into account the possibility that insufficiently intensive monitoring will not detect key changes;
- Intensive research on selected species and ecosystems to provide the basis for more informative monitoring and more effective interventions;
- Research approaches combining sampling of key taxa and with long-term ecological observation;
- Agreeing international and multi-scale protocols for the monitoring of biodiversity in different habitat types, perhaps based on techniques used in the Pan European Common Bird Monitoring Scheme;
- Developing monitoring methodologies for complex high-biodiversity groups or habitats;
- High-tech methods, like sound recognition, for birds, certain bats, certain frogs and certain insects or developing monitoring schemes for lay people and developing statistical methods capable of dealing with such non-standard sampling;
- Optimising, standardising and calibrating monitoring of temporal changes in plant richness as well as "averaged" indices over the community to reduce biases and help reveal mechanisms;
- Developing technologies and databases that speed up (a) access to taxonomic and biogeographic data; (b) re-identification of already known species; (c) description of new species; (d) re-identification of yet unnamed species; (e) quantitative assessment of species diversity;
- Measures to prioritise taxonomy effort, including clarity regarding the needs of the users, digitised access to data and wider appreciation by development projects that taxonomy information comes at a cost;
- Studies should not neglect marine biodiversity, seamounts and effects of gas hydrate emissions.

2. Biodiversity functions, changes and adaptive capacity:

- Developing science-based strategies and tools for sustainable management and conservation of genes, species and ecosystems;
- Analysing of the consequences of biodiversity change on ecosystem function, and services to local, national and continental economies and society, integrating the economic equivalent of these changes;
- Assessing change in biodiversity in different biomes, integrating analyses of the drivers of change, and understanding of the underlying processes and mechanisms which govern change;
- Exploring interrelations between genetic, species (population) and ecosystem biodiversity, as well as scale (temporal and spatial) problems;

- Research on climate change, flood, drought and fire impacts in developing countries and how this influences biodiversity conservation and sustainable use;
- Science-based strategies and tools for sustainable management and conservation of genes species and ecosystems;
- Understanding the dynamics of interactions between organisms in changing habitats, and the impact of economic and social change through modelling.

3. Technological, societal and political aspects of managing biodiversity (e.g. EU, GEF and CBD programmes):

- Developing tools for modelling future scenarios for management and preventive land use planning, management of biodiversity on the regional scale, management and development of techniques of land use systems and use of natural resources;
- Accounting for ecosystem services in other parts of the world when doing sub-global MEA-like assessments;
- Gathering (meta) data on protected areas and biosphere reserves which are open to all researchers who want to work with them in order to be able to measure the success of conservation measures, including societal consequences;
- Research on the impacts of Europe on the biodiversity of southern countries, including the consumption of goods and services from the south (e.g. primary products, services such as tourism), and the impacts of development assistance;
- The development of a system on how the information and the databases generated through research projects could be maintained and updated in the longer run (role for GBIF, ENBI etc);
- Building of national capacities, including stable north-south partnerships and emphasis on developing local field skills as well as institutional expansion. This will include target-setting for biodiversity identification and sustainable exploitation skills in development and research projects;
- Research on biodiversity modelling combined with modelling of societal and environmental pressures to predict ecosystem function and services and effects of policy changes;
- Development of an African biodiversity observation network, which integrates research for innovative approaches to sustainable resource use and is linked to the EU GEOSS system;
- Evaluate the effects of EU and national land use policies (e.g. CAP reform, water directive, soils directive, bio-energy) on biodiversity;
- Research on the maintenance cost of ecosystem services in decision-making;
- Quantifying the impact on biodiversity of policy decisions in producer countries on other parts of the world (e.g. imports or tourism).

4. Interactions with other policy domains (trade, food, health, combating poverty, biotechnology):

- Developing socio-economic and policy concepts for a realistic and feasible transformation from present exploitation practices to sustainable land and resource use regimes and governance patterns;
- Interdisciplinary applied research involving long-term participation of local stakeholders (national government, local government, extension officers, local researchers, community groups) and international stakeholders (national institutes, universities, CGIAR institutes);
- Communication and learning partnerships with resource users and other stakeholders at the levels of households, farms, villages, nations and regions;

- Development of new types of regulation, based on natural capital, as recommended by the Millennium Ecosystem Assessment.

Session III: Biodiversity and ecosystem services: the Millennium Ecosystem Approach concept from a European perspective

1. The theoretical and methodological basis:

- Testing the applicability of main MA-framework aspects in a European context in a multiscale approach;
- Develop appropriate valuation techniques enabling costs of changes in ecosystem services to be calculated and improve methods to quantify ecosystem services;
- Increase the knowledge on the real effects of loss of some services for ecosystems and humanity;
- Evaluation of existing policy measures for their applicability within the ecosystem services concept (link to Session I topics);
- Research into methods of expressing and articulating plural and multiple values and designing institutions which are able to protect and nurture them;
- Data and indicators for ecosystem services: Evaluation of the situation in Europe to ensure quantitative outcomes to enable a better assessment of the sustainability of ecosystem service provision and consumption.

2. Biodiversity explicit links to ecosystem services:

- Analysis of the shortcomings of the ecosystem services concept in the context of biodiversity conservation and the intrinsic values of biodiversity;
- Development of concepts like Service Providing Units to link ecosystem services;
- Understanding the contribution of biodiversity to services such as resilience and resistance and nutrient cycling;
- Improve knowledge on the links between ecosystem functioning and ecosystem services.

3. Assessments on different scales:

- Development of a framework for a multi-scale assessment across Europe - from the local level to a pan-European scale;
- Development participative methods for selecting the most relevant ecosystem services and decide about priorities;
- Defining the 'relevant ecosystem service unit' from both the 'supply' and 'demand' side, identifying proper scales for assessments;
- Effects of European consumption of ecosystem services in other parts of the world (link to Session II);
- Addressing uncertainty of the provision of ecosystem services under changing land use and climate change.

List of contributions

Session I: Research contributing to reaching the 2010 target in the wider countryside

Session II: European biodiversity research and the global perspective

Session III: Biodiversity and ecosystem services: the Millennium Ecosystem Assessment concept from a European perspective

Session I: Research contributing to reaching the 2010 target in the wider countryside

Session I Introduction: Research contributing to reaching the 2010 target in the wider countryside

Klaus Henle, Session I Chair

The wider countryside covers a large part of the European and global terrestrial landscape, and a considerable part of biodiversity depends on the adequate management of the wider countryside. The goal for the wider countryside must be to maintain or restore robust functional ecosystems as a basis for sustainable development, securing long-term ecological favourable conditions. Only then can the loss of biodiversity be halted and the social, economic, and cultural value for people living in and depending on the wider countryside be secured.

The management of the wider countryside has been continuously changing with political and societal changes. Do we have sufficient baseline information about status and trends of biodiversity in the wider countryside? Do we have adequate monitoring systems in place for status and trends in biodiversity as well as for the effectiveness of policies and for biodiversity related conflicts? What are the research deficits and priorities and how can we better manage the existing but widely dispersed knowledge base?

Four major trends can be seen that strongly affect biodiversity and biodiversity related conflicts in the wider countryside: intensification, abandonment of marginally productive (but High Nature Value) land, changes in the scale operations, and the emergence of new pressures, for example, the new frenzy about an increase in biofuel production to combat climate change and the misuse of energy as a political weapon. These trends are caused by various pressures and ultimately social, political, and economic changes.

A multitude of measures have been developed and implemented to address the first three of the trends mentioned above and many conservation measures are implemented in the wider countryside. For example, in Europe every year billions of Euros are spent on agri-environmental schemes. However, the overall outcome is not (yet) satisfactory. Why? What are the constraints and what can research contribute to eliminate the constraints?

Likewise, we have a considerable knowledge about pressures that act on the wider countryside, such as habitat loss and fragmentation, pollinator loss, and pollution but our ability to use this knowledge to influence political and land user decisions towards sustainability is still limited. Do we need to continue research on these pressures or is it mainly a matter of improving/developing new tools for implementing existing knowledge? What are the priorities for tools and what should research contribute? Can we apply our knowledge to new emerging pressures, such as widespread production of biofuel, in such a way that clearly unsustainable directions can be avoided right from the start?

Do we adequately understand the interrelationships between societal and political changes, such as the European unification process, biogeographic differentiations, land use decisions in the wider countryside, and the fate of biodiversity in order to manage the wider countryside sustainably? Do we sufficiently understand global trade and policies to predict likely future developments of land use in the wider countryside and the likely global environmental effects, particularly on biodiversity, under changing political agendas?

Although, biodiversity loss has not yet been topped in the wider countryside, conservation efforts and management approaches have also seen some spectacular

successes, we can be proud of. For example, several large vertebrates return to territories from which they have been extirpated in the past. The returning animals cause great conflicts among humans, especially among those that enjoy and love these animals and those that have to bear the costs when the returning species compete with land users on natural resources. How can be turn these conflicts into a win-win situation? What are the priorities for research in this context?

It is apparent that there remain major challenges for reaching the 2010 target and beyond in the wider countryside. Where should we go from now to 2050 and what are the research needs and priorities to make sure that we are much closer to the target than currently?

Looking forward to your thoughts on these questions during the e-conference.

Economic viability of regional farming systems

Jan Jansen, Radboud University Nijmegen, the Netherlands

For thousands of years the major common system in the wider country-side of West-Europe was the heathland-based farming system. In principle it had the same structure everywhere: on the one hand close to the settlements there are small labour-intensive areas (mostly called infields) where man raised his crops and kept meadows and further away there are large labour-extensive areas where man kept his animals for grazing (mostly called outfields). The crops needed large quantities of nourishment for plant production. This was delivered by the outfields. So in all these systems there was a net flux of nutrients and energy from the outfields to the infields. Heathlands in Europe have been the "outfields" of heath farming systems.

In the course of the 19th century this system collapsed and heathlands got other functions, i.e., plantations, nature areas, military, etc. Infields persisted but from that moment on infields were more and more nourished with nutrients from other sources. Now even these fertile infields, covering large areas of the wider countryside, are becoming marginal agricultural land. According to Diemont et al. (2007) this problematic situation provides an opportunity for establishment of extensive heath farming systems in cooperation with nature conservation organizations. In particular near the cities and metropoles in Europe there is a demand for local food and maintenance of an attractive open landscape, which could be provided by these extensive "heath farming systems". In case sufficient agricultural land is used in an extensive way, water pollution by agriculture can also be avoided without additional costs. Extensive heath farming systems could also contribute to a more effective management of heathlands and pasture in Natura 2000 areas, halting the loss of biodiversity both in nature areas and the adjacent wider countryside. In the vicinity of the metropoles in Europe there is already a demand for such extensive farms, which provide local produced food while maintaining an attractive open landscape.

The question to be answered is whether these modern heath farming systems will also provide a new economic perspective. Even if there is a demand from society to maintain these heath landscapes, the question is whether there are farmers willing to change towards extensive farming. The farmers' answer will depend on the possibility to make a living. So we have to examine the economic possibilities.

In the more remote areas in Europe extensive afforestation is often considered the best option where the indigenous farming populations are in severe decline and there is resultant large-scale land abandonment. In Portugal, for instance, areas once characterized by traditional farming now carry vast pine and eucalyptus plantations. This was considered an economic success, especially as Portugal became a timber exporting country. Now there are voices stressing the properties of forests being carbon dioxide sinks. This is true. Within a relatively short period, however, the modern plantation landscapes of Portugal proved to be extremely vulnerable to wildfires. The consequences have been serious and far-reaching and also persistent as in the post-fire erosion landscapes, pine and eucalyptus are rather resilient compared to most other species. In addition huge amounts of carbon previously removed from the atmosphere into biomass now were ignited as biofuel and released again.

In the absence of carefully thought-out management practices, the cycle of erosion, land slides, obstructed rivers, risks of floods, water pollution, wildfire induced carbon dioxide production and loss of biodiversity, will remain unbroken.

The solution lies probably in an integrated ecological, economic and social policy for tackling marginal (mountainous) areas.

Fortunately in a few remote areas in Portugal, such as certain parts of the Serra da Estrela, traditional heathland-based farming continued, giving way to beautiful traditional landscapes with extremely high biodiversity and offering ecosystem services that are only now recognized (see also session III).

Fig. 1 Traditional farms with rotation system of ploughed lands, rye-fields and fallow lands including broom (Serra da Estela, Spring 1996, Jan Jansen)

Fig. 2 Irrigated hay-meadows, ploughed fields around farmhouse (casal) surrounded by rye-fields and outfields predominated with white-flowered broom *Cytisus multiflorus* (Serra da Estrela; early spring 1998, Jan Jansen)

If that farming could continue, a large number of Natura 2000 biotopes could be preserved and in these landscapes there are no wildfires.
It may also be an answer to the countryside exodus and land abandonment that so seriously affects the viability of rural areas.

Conclusions:

- Especially in remote areas where traditional farming is still practiced, the economic possibilities of farming should be re-examined. What once was regarded as old-fashioned may become a viable option, albeit modified to suit present conditions.
- In addition economic possibilities of reintroducing heathland-based farming close to densely populated areas should also be researched.
- Be careful with introducing biofuel production. Its economic possibilities and ecological consequences should be researched.

RE: Economic viability of regional farming systems

Richard Hardwick, European Commission, Brussels, Belgium

In response to Jan Jansen's contribution:

1. Surely the economic possibilities of farming in marginal areas been sufficiently researched already? See e.g. Breustadt and Glauben (2007) J Agric Econ 58, 115-127.
2. In W Europe, mean net disposable incomes have increased year on year, and mean % expenditure of personal income on food has decreased. So the standard of living of many farmers and their families has regressed, relative to the rest of us. And the number of farms and of farmers has declined. I suspect that the trends will continue during my lifetime at least.
3. Consider the situation of a bright 25 year old from a family farm in some remote area who has the offer of a tenured University post. Would you advise her to turn down the offer, go back to the farm, and spend the rest of her life there?
4. Isn't the rational integrated ecological/economic/social policy - to let the land revert back to climax vegetation (usually but not always climax forest)? Its not necessarily catastrophic - c.f. the history post 1850 of farm- (now forest-) land in central Massachusetts.

RE: Economic viability of regional farming systems

Jan Jansen, Radboud University Nijmegen, the Netherlands

1. The paper of Breustedt and Glauben does not examine the additional functions of a farmer, like safeguarding the Habitats Directive, Birds Directive, Nitrate Directive, Water Directive to mention a few. I think it is important to value the work of traditional farming in terms of nature conservation, water management, support of leisure economics via attractive landscapes, etc. I have studied the region of Serra da Estrela and found a landscape that could be a reference area for a number of Natura 2000 areas in NW-Europe. In Portugal that landscape has been clearly shaped by farmers and by farmers only. No need for nature conservation organisations. So if the

farmers would get paid for nature conservation just by doing their job as a traditional farmer then some very nice areas could be saved (See Jansen, 2005 for more details).

2. That's correct and we should investigate how to change that trend.

3. Not under the present circumstances. But traditional farmers from Portugal are great nature conservationists. It is very hard for farmers to continue and under present circumstances they will quit, hardly any doubt. But if you really value the extras of traditional farming and would be willing to let farmers participate in the financial benefits then they might have a chance to continue. And that is what I would like to find out, e.g. studying the extra values in Estrela and other areas e.g. N-Portugal where farmers escaped a landscape that is still full of biodiversity at present.

To give you an idea of the possibilities. In a small area of about 15,000 ha in the province of Noord-Brabant (The Netherlands) almost 30 million is costed to subsidise restoration projects to maintain regarding the quality of the cultural, natural and environmental aspects of the agricultural landscape for the coming decade only. Applied to Estrela, such a programme that would give an restoration amount of some 200 million. They have no extra income and that finishes them. It is really a big mistake we make. We should help these people and give good arguments to politicians to do so. Therefore an investigation in the real economic possibilities under the new circumstances could help a lot. Politicians especially want to have economic arguments.

4 OK you can let the land go back follow succession. And in some cases that is alright to me. It is necessary for the mosaic in the landscape. But large forests may cause large wildfires especially in southern areas although with the present climate change in northern countries this risk may raise. In addition you will lose biodiversity, but that may be alright under certain circumstances.

Perhaps we should really look at the definition of a farmer. The definition of farmer was shifting the last decades to industrialist. In nature conservationist circles that term has a negative connotation but we have to make clear that it is not everywhere the same. We cannot do without intensive husbandry because we have too many mouths to feed. Remember that the world's population went up from about 1 billion in the 19th century to some 6 now. We are not dependent anymore on the local circumstances, because of technology. But socially and ecologically spoken we have not found a good answer yet.

Sustainable agriculture and forestry systems

David Pimentel, College of Agriculture and Life Sciences, Cornell University, Ithaca, New York

Summary: The author argues for the encouragement and implementation of sustainable agriculture and forestry systems, as well as a range of policies and measures to minimise threats to biodiversity.

At the present rate of species loss, half of all existing plant, animal, and microbe species on earth will become extinct by the end of this century. This projected high rate of extinction due to human activities is alarming because many of these organisms are vital to the safe and productive function of ecological systems that sustain our planet and the global economy. Indeed, agricultural productivity and public health depend on the activities of diverse natural biota. An estimated 15 million species of plants, animals and microbes fulfil the ecological needs on earth.

Although efforts to curb the loss of biodiversity have intensified in recent years, we have not been effective in countering the accelerating human population growth and the increasing destruction of natural habitats. The introduction of alien invasive species throughout the world continues to alter and damage natural and managed ecosystems. Moreover, additional complementary strategies are needed to protect small organism species, such as insects, bacteria, and fungi, which are essential to the structure and function of natural ecosystems.

Protecting national parks has been the prime focus of world biological conservation. Often overlooked but equally vital is the protection of biological diversity existing in our vast agricultural, forest, and marine ecosystems, as well as within human settlements. All these combined cover approximately 80% of productive terrestrial ecosystems.

Conservationists are dedicated to protecting biodiversity and implementing sound conservation policies. Unfortunately, most conservation policies are established by economic planners, agriculturists, foresters, and corporations, and do not originate from conservationists themselves. In the light of species loss and growing pressures on biodiversity worldwide, it appears that the only way that biodiversity can be saved is by saving the total biosphere.

One win-win approach is to strive for sustainable agriculture and forestry systems because most plant, animal, and microbe species exist in these ecosystems that cover most of the terrestrial ecosystem. Also, agriculture and forestry ecosystems are the most favourable systems in terms of moisture, soil, nutrients, and temperatures. Maintaining biological diversity is essential for sustainable and productive agriculture and forestry systems. Biological diversity can best be protected by: maintaining abundant biomass and habitat diversity; conserving soil, water, and nutrient resources; reducing water, soil, and air pollution; and reducing global warming.

The public, as well as political leaders, must give high priority to protecting biodiversity and the total biosphere. I recommend that the U.S. and other nations take the following policies to enhance the conservation of biodiversity:

- Encourage and implement ecologically sound and sustainable management practices for agriculture, forestry, and fishery systems

- Implement policies to prevent the introduction of alien invasive species in the U.S. and other nations
- Reduce water, air, and soil pollution that threaten species survival.
- Conserve and reduce fossil energy consumption to reduce green house gases and global climate change.
- Set aside more ocean as enforced marine protected areas.

Re: Sustainable agriculture and forestry systems

Tor-Björn Larsson, European Environment Agency

Thanks for pointing at the need of sustainable forestry systems. I would like to reflect at bit further from a European perspective on the forests and the implication this may have on preserving forest biodiversity.

The recent forest resource assessment (UNECE/FAO, 2005) shows that the main part of forests in European countries is considered as semi-natural owing to intense management. In e.g. the Czech Republic, Finland, Germany, Netherlands, Norway, Poland, Serbia Montenegro and Switzerland, the share of semi-natural forests exceeds 90% of the total forest area. Only if we include the vast forest resources of the Russian Federation (including Siberia) the picture changes in favour of large areas of primary forest modified natural forests with little human influence. Plantations - i.e. planted homogenous forests often monocultures of an exotic tree species - are generally not dominating in Europe; in West Europe the share is only about 6% of the total forest area (the proportion of plantations is, however, quite considerate in some countries).

The above shows that forestry building on natural forest tree species dominates in Europe and also that it is in the landscape of these semi-natural forests that biodiversity will have to be preserved. The Ministerial Process for the Protection of Forest in Europe (MCPFE) is the high-level forum to agree on principles for sustainable forest management. MCPFE has agreed biodiversity concerns in forestry, as well as reporting of a number of biodiversity related indicators. In a recent assessment mainly based on the MCPFE indicators by European Environment Agency (EEA, 2006) it is concluded that there has been significant progress towards halting biodiversity loss in European forests (while this is definitively not the case in some other ecosystems, most notably not in the marine environment).

However, it is not enough that the erosion of biodiversity in European forests seems to have been halted. We know for sure the semi-natural forest ecosystems - and even more plantations - differ from the natural, un-impacted, forests and it is hard to believe the biodiversity state of European forests is satisfactory from all aspects (cf. e.g. the fact many forest species are threatened). More knowledge is needed to identify the necessary improvements needed and how to reach these improvements in a cost-effective way by adapting forestry practices and/or protecting particularly important forests. Given the forest conditions in most parts of Europe it is hardly realistic to establish large enough protected areas to consider these independently from the semi-natural forest landscape with ongoing forestry. Furthermore, as the forest landscape by nature is dynamic (comprising successions driven by disturbances) most effective may be to develop a strategy including time-limited protection of otherwise disfavoured forest succession habitats (e.g. late succession stages, early forest fire created habitats).

Re: Sustainable agriculture and forestry systems

Mauro Agnoletti, University of Florence, Italy

1) The classification of FAO regarding the origin of EU forests raises many doubts. According to the same standards the recent assessment of the Italian Ministry of Environment classify all forest areas as having natural and semi-natural origin (Barbati et al 2004). The extensive research carried out on the history of these forests shows that man has influenced all their features: extension, structure, density, species composition etc. in the last 2000 years. Therefore, saying they have natural or semi-natural origin is mostly a conventional terminology not reflecting their real origin, but causing several problems.

2) This aspect is even more evident when you visit areas classified into the NATURA 2000 network. Many descriptions try to present a potential natural vegetation model that often fails to recognize that e.g. the natural habitat "Dunes with forest of *Pinus pinea* and *Pinus pinaster*" code n. 2270, have been all planted by man, they are not natural at all. On the other hand, you cannot cut the natural regeneration of *Quercus ilex* of the understory, necessary to maintain these forests, because you are in a protected habitat. There might be many examples here, so do not think this is just an isolated case (Agnoletti 2004).

3) Plantation of monoculture, mostly *Pinus nigra*, not a native species in Italy, forms a large part of the 1.000.000 ha of forest planted by forester during the last century in Italy. An important shift towards conifer plantations has affected most of European countries in the last 150 years, increasing their original extension even by 100% in France, Italy, Germany, Slovenia, Belgium (Johann 2004).

4) Concerning biodiversity many people (officers in charge of evaluation) confuse the increase of forest cover with the increase of biodiversity. If the beech forest of the Apennine mountains (Italy) sees an increase in the last 100 years, or we have 3 times more forest in Italy than 100 years ago, that doesn't mean that there is more biodiversity, but simply that we have more forest of beech, because beech has never been endangered, as well as many other forests originated by secondary successions (Agnoletti 2006).

5) Therefore, while many people are happy for the continuous extension of a dense, homogeneous forest cover, few of them seem to realize that simply by changing our standard in monitoring system we might have noted that in the last 100 years we have lost 40% of biodiversity linked to open spaces (pastures, wood pastures and fields with many species of tress) in all Tuscany (Agnoletti 2006). This kind of biodiversity has not a natural origin, but represent important habitat types, as well as forests, and should protected. But, as many think that fragmentation is a danger, nobody see this as problem, or the need to open gaps in forest areas. The indicators considering biodiversity in MCPFE standards should be implemented according to this view.

6) This is also one of the reasons why MCPFE recently took the decision to create an international expert group proposing guidelines and new indicators to take into consideration this problem and, more in general, the cultural origin of EU forest. However, it will be not an easy task, because the ideas driving most of biodiversity conservation clearly did not take into account this problems and the existing criteria and indicators are in accordance with this view. As a matter of fact, according to our law, we cannot restore a pasture land in Italy, while the disappearance of pastureland in favour of a new forests could be easily certified by any certification standard.

Re: Sustainable agriculture and forestry systems

Petr Petøík, Institute of Botany, Academy of Sciences of the Czech Republic

Here I present some results from the national review employed in the BioStrat project concerning the Czech forestry practice and research needs (see Fanta et al. in Petøík et al. 2007).

Biodiversity of Czech mountain forests and freshwaters has been significantly reduced by high acidification and eutrophication since the 1950s. Vast monoculture plantations of the Norwegian spruce decrease biodiversity, enhance acidic deposition (dry deposition onto canopy) and consume a lot of essential nutrients from soils. Moreover, foresters fertilized soils with nitrogen in forests despite of its high level in air and water solutions. Hence, forest and agricultural management practices dramatically delayed soil and water recovery in respect to chemistry as well as biodiversity (cf. Emmer et al. 1998, Hruška and Cienciala 2003).

In the Czech Republic there is not enough intensive and widespread research dealing with forest ecosystems biodiversity. Teams dealing with biology and landscape ecology are usually not well connected with those studying atmospheric deposition, soil science, soil and water chemistry. There is no cooperation between academic natural science (meaning biology, geochemistry etc.) and so-called forest science. The forest science is oriented to production and increasing benefit while biodiversity is not yet the important goal either for such research or capacity-building. There is also a huge gap between findings of natural scientists and industrial forestry management. Coordination of activities amongst the individual sectors is unsatisfactory and the competence is not clearly defined. There is not enough demand for knowledge at responsible institutes (Ministry of the Environment and Ministry of Agriculture). As a result, national funding sources for complex biodiversity research are very limited.

Started in spring 2006, a group of Czech scientists protested against such an unsustainable management in forests and suggested improvements focusing on biodiversity (http://lesy.drosera.cz/?eng). The main task of the scientists from the Czech BioPlatform is now inter alia the reduction of deer population and using assessment of deer stock according to damaged vegetation (in Europe, only in the CR and Hungary is the method not applied). Secondly, despite involvement of some old and open forests into the European Community Natura 2000 network, some organisms living there are close to extinction due to the current forest management. In this case, alternative management (e.g. forest grazing or coppicing) is proposed by our BioPlatform group.

There are several research projects dealing with biodiversity in the Czech Republic (http://aplikace.isvav.cvut.cz). The central role of concerted action is the Biodiversity Research Center, a network of research institutions involved in biodiversity studies and international projects or centers of excellence which aim to educate young researchers. In the Czech Republic, however, the results from various biodiversity studies are only rarely linked to conservation practices and insufficiently acknowledged by policy- and decision-makers.

We therefore call for the creation of a team of scientists and decision-makers who recommend further steps in forestry management (particularly) based strictly on scientific results. As for forestry sector, the following research is needed:

- To compile a comprehensive methodology for monitoring changes in forest species diversity in order to integrate various systems of monitoring schemes for the evaluation of forest ecosystem conditions.
- To assess the impact of the Czech forestry policy and management on the current situation and future development of forests and to integrate new methods of evaluation of the carrying capacity and vulnerability of the forest ecosystems in land-use planning. This is in close connection with research on the influence of various forest categorization and certification systems on biodiversity in a broad sense.
- To develop further studies on the evaluation of mechanisms and sources of biodiversity changes on genetic, species, population, ecosystem, and landscape levels.
- Finally, we recommend focusing research on priorities as they were formulated in several recommendations of the European Platform for Biodiversity Research Strategy (www.epbrs.org) or in other strategic documents (e.g. EEA 2006) and projects (e.g. Life Watch etc).

Pollination in a landscape context

Teja Tscharnke, University of Göttingen, Germany

Summary: The author discusses the importance of the landscape perspective in understanding patterns in functional biodiversity patterns and the relation of biodiversity to ecosystem services and calls for more research on the relative importance of local and landscape management for biodiversity and its relation to ecosystem services such as pollination.

Understanding patterns in functional biodiversity patterns, and the relation of biodiversity to ecosystem services, needs a landscape perspective, because most species experience their surroundings at spatial scales beyond the plot level, and a spill-over across natural and managed ecosystems is common. In the dynamic, agricultural landscapes, only a diversity of insurance species may guarantee resilience, i.e. the capacity to reorganize after disturbance. Interacting species experience their surrounding landscape at different spatial scales, which influences trophic interactions such as plant-pollinator interactions.

Structurally complex landscapes enhance local diversity of pollinators in agro-ecosystems, which may compensate for local high-intensity management. Organisms with high dispersal abilities appear to drive these biodiversity patterns and ecosystem services, because of their recolonisation ability and larger resources experienced.

Bees in the countryside have a wealth of different pollinator guilds, including social honeybees, foraging at very large distances and concentrating at highly rewarding resource patches. Social bumblebees show a range from small-scale to large-scale foraging, depending of the bumblebees' body size. The landscape scale experienced by solitary bees is also determined by body size, with larger species foraging at larger scales, but is generally limited to a maximum of a few hundred meters.

Agri-environment schemes, which are incentives for farmers to benefit the environment, need to broaden their perspective and to take the different responses to schemes in simple (high-impact) and complex (low-impact) agricultural landscapes to management into account. In simple landscapes, local allocation of habitat is more important than in complex landscapes, which are in total at risk. However, little knowledge of the relative importance of local and landscape management for biodiversity and its relation to ecosystem services such as the pollination of wild and cultivated plants make reliable recommendations difficult.

Research needs in relation to habitat fragmentation and biofuels

Giselher Kaule, Institute of Landscape Planning and Ecology, University of Stuttgart, Germany

Summary: The author emphasises the need to strengthen the coherence of the Natura 2000 network and highlights a number of research needs related to this goal.

A strong concept to maintain and develop European biodiversity is the NATURA 2000 network of protected areas. Annexes I and II structure this backbone of European biodiversity. An important key target is the strengthening of the coherence of the network. Indeed, the infrastructure network for the network is overlaid and crossed by the physical infrastructure network of the human population, which is fragmenting the network and the landscape matrix. The pressure for upgrading the human transportation network and the trend of (sub)-urbanisation is faster than the establishment of the nature conservation network, all of which result in the coherence of the network to decrease.

Maintaining and upgrading the landscape permeability is a target of modern nature conservation programmes and standard in EIS and development planning. Green bridges are implemented; large less fragmented sections have priority for maintenance. Significant knowledge gaps are the effectiveness / the long-term success of these measures. We have some data on migration distances, on transport vectors for organisms but big knowledge gaps remain, including:

- Habitat conditions for colonising
- Conditions for developing stable sub populations
- Hard data and thresholds for the value of large infrastructure net meshes

The fragmenting human infrastructure is imbedded in the landscape matrix: agriculture, pastures, forests and mixed landscapes. These land uses support the habitat network or create additional strong barriers. The pressure on developing the bio fuel market has started to induce landscape changes at even faster than the EU agro revolution in the past. Intensification becomes attractive, marginal land set aside areas will be “reactivated”, the open land - forest border, an ecologic highly sensitive structure will be changed. Short-term rotation systems with woody plants are economically interesting and ideal from the energy viewpoint. The chemical landscape impact (nitrogen, phosphate) is limited. Unfortunately biodiversity will be – as often – the looser. A big challenge will be the defence of the extensive pastured semi-open landscapes and the old natural forest stand network in the context of NATURA 2000. The development of sustainable rotation systems, which include the production of biomass for bio fuel, is a challenge.

A biodiversity friendly solution would be the harvesting and use of bigger branches, the bark etc, which was worthless in modern timber production systems. Diffuse nitrogen input is impacting the forest biodiversity, harvesting more biomass (as in pre-industrial times) could reverse this development. This option is not promoted in scenarios with significant biomass production and the optimistic prognosis of bio fuel development. Scenarios that optimise the availability of bio fuel depend on forest plantations.

A significant knowledge gap and research challenge is the impact of the new forest matrix on biodiversity and the “design” of the habitat network which could mitigate this development.

The process of reaching a target needs controlling. We increasingly tend to use in computer models exclusively existing data. The gaps are validated models in the landscape scale. A frame research programme should focus on drafts, which develop scenarios and include a prognosis of biodiversity development. Monitoring programmes, which allow an interpretation of the results, are definitely missing. A renaissance of field studies is needed.

Recognition of ecosystem services, biodiversity evaluation and feedback mechanisms

Ernst-August Nuppenau, Institut fuer Agrarpolitik und Marktforschung, Justus-Liebig-Universitaet, Giessen, Germany

Summary: The author calls for increased research on feedbacks between biodiversity and farm behaviour, including a better understanding of dynamic decision making and the identification of patterns that enable scenario building on farmer responses to a changing environment.

It can be assumed that climate change and its impact on plant growth has profound impacts on farm behaviour and land use. Already, farmers have recognized that plant growth seasons are longer. In spring particularly, earlier mowing and maturing of crops has created different land use options, which can be characterized by the opening up of a further intensification; though this maybe different at research sites in the South West, Central and East of Germany. In addition to their climatic recognition of the environment, farmers face new challenges, especially weed and pest problems. These recognitions are resulting in different strategies of land use. It is a prime hypothesis of this project that farmers can amplify the effects of climate change and contribute to further reduced biodiversity. Biodiversity is considered as part of ecosystem-services and we need the recognition of the value of biodiversity by farmers; or alternatively formulate, to understand strategies of farmers based on ecosystem service valuation. The value of a diverse environment and its contribution to production and income has to be understood in order to find answers to how farmers can be integrated into biodiversity conservation. Within a framework of testing of options and strategies for responses to climate and biodiversity change we will acquire knowledge how a feedback mechanism or circular impact of biodiversity change and land use, driven by, for instance, climate change and human strategies for nature use, can be envisaged. A secondary hypothesis is that by a better understanding of the value of biodiversity a vicious cycle can be broken. In particular we try to identify crucial valuation aspects of biodiversity.

It should be the aim of research to identify feedbacks between biodiversity and farm behaviour. A focus must be given to a better understanding of dynamic decision making as related to changes in biodiversity, land use and farm strategies. To cope with change, on the side of farming, one has to identify patterns that enable scenario building on farmer responses to a changing environment. Assuming substantial climate and biodiversity change over next decades, it must be tested whether farmers' negatively or positively accelerate and how they respond.

One can work with a bio-economic model to investigate links between eco-system service notification and optimisation of farms. Such modeling should firstly provide a baseline survey on existing and potential farming system options in case studies as related to local land use and eco-system services. This implies a collection of information on input and output coefficients as well as the use of external and internal valuation tools in agronomy. We can combine a dynamic programming model to anticipate land use change, see farmer response and make prognoses. Such prognoses may contain seasonal behaviour, crop mix and evaluated productivity of meadows. Based on a special tool to be developed to appreciate the eco-system

service of diversity, the agronomy can respond to an increased threat of loss of biodiversity.

The prime delivery of a programming tool is a rigorous process of local information gathering on the economics of biodiversity and evaluation of services as well as an establishing of a link between farming diversity and biodiversity. From the point of view of getting a value of eco-system services, being a productive asset, farmers may become involved by using planning tools encompassing biodiversity. Then strategic and behavioural planning concept for land users to better notify biodiversity can be established, enabling a long-term economic monitoring. Research on biodiversity evaluation complements natural science aspects of biodiversity with social science aspects of land use change detection. By depicting farm behaviour through analytical tools of modeling we reach a position to respond to changing ecosystem scarcity.

Agricultural development in the new member states

Tiiu Kull, Department of Botany, Estonian University of Life Sciences**,** Estonia

Summary: The author identifies threats to biodiversity from agriculture in the new member states and highlights the need to research the impact of energy crops on biodiversity, and determine how different species support each other in extensive farming.

In the middle of the 20th century, after World War II, a severe intensification period in European agriculture started. This trend took place in the East and West, although the policies (collectivisation and CAP) were different and partly also the extent. The results were nearly too good and the production reached very high levels with harsh environmental consequences. Intensification of the agricultural sector also resulted in irrigation works and the drainage of many wetland areas. After the collapse of the Soviet Union, agricultural production declined drastically in Eastern Europe due to non-subsidised fuel, fertilizers, and chemicals, and of course, due to loss of the former market. Nowadays a lot of agricultural land has been abandoned in new member states (10-40%). However, problems in the oil sector and EU plans to extract more energy from bio-production will probably soon lead to huge mono-cultural fields with energy crops (even dangerous aliens) that can harm biodiversity. Therefore we need research on the impact of different spatial schemes and management techniques of different energy crops on biodiversity, and we should study the possibilities of how to regulate the spatial planning principles.

Organic farming has proved to be biodiversity-friendly. Traditional farming has created the most species-rich semi-natural communities known on the world scale. However, sound scientific evidence on how different species support each other in these systems are still insufficient which hinders the transition from conventional farming. It would be important to try to formulate the necessary conditions for an agricultural management of landscape that would increase the level of biodiversity of the communities (without introducing alien species).

Comments and suggestions from national perspective – Romania

Angheluta Vadineanu, Department of Systems Ecology and Sustainability, University of Bucharest, Romania

Summary: The research on biological, ecosystems and landscapes diversity has to rely on holistic and hierarchical approach at regional, national and European scales; to have a sound inter and transdisciplinary character; and to allow for long term research and knowledge transfer to the decision cycle.

The goal of sustainability at the local, national and European or at the global scales is highly dependent on building and continuously improving scientific and technological background regarding the biological and ecological diversity, which strictly allows for conservation, restoration and sustainable use of their components and / or their resources and services. This short keynote contribution consists in a few brief comments and suggestions related to the topic of the session, which is derived from a wider and recent contribution to the national RDI strategy and programme (2007/2013) (Vadineanu 2006).

a) Major gaps in biodiversity research and knowledge:

- Although there are few exceptions (e.g. Lower Danube Wetlands system) (Vadineanu 2007, Vadineanu et al. 2003), most of the research activities are designed and carried out at small space and time scales, and focused on describing species or higher taxons richness or on the structure and dynamics of some particular species within some particular ecosystems. It is, therefore, hard to find consistent and accessible (in many cases reliable) data and information showing the shift in the trend and rate of biodiversity changes at regional, national and European scales due to the implementation of particular policies and measures.

- The functioning role of the dominant populations / species, tropho-dynamic modules and communities has been addressed rarely and in a sectoral and reductionistic manner, which explains the current difficulties in assessing the major functions and services flows for different types of ecosystems and land or waterscapes.

- The research on biodiversity (biologic and ecosystem diversity), climatic system and on socio-economic system (structure and metabolism) are designed and carried out on parallel ways, with lack or very poor integration of research activities and their scientific products. In these circumstances it is not surprising that we are still facing many difficulties in identifying and describing the complex structural and functional links between these three major components across space and time scales. That explains also the lack of synergy between the programmes of implementation of the global conventions – CBD, FCCC, CCD, or of the EU – directives and of national legislation.

b) Suggested and accepted specific research framework and objectives within national RDI programme (2007/2013):

- The research on biological, ecosystems and landscapes diversity has to rely on holistic and hierarchical approach at regional, national and European scales; to have a sound inter and transdisciplinary character; and to allow for long-term research and knowledge transfer to the decision cycle. This is expected to be achieved by

developing the national LTSER network (Long Term Social Ecological Research) and linking it into EU LTSER-network and ILTER

- The research should address the biological diversity at gene, population / species, community levels (including human cultural diversity) and ecological diversity at habitat, ecosystem, and / land / waterscapes and, subregional and national socio-ecological systems.

- The results of research activities have to allow the understanding and modelling of dynamics in the composition, structure and functioning of the components of biological and ecological diversity under the pressures of major human and natural drivers (including climate changes)

- One major target of the accepted programme is dealing with the identification and description of the population, community, ecosystem and landscape functions, and the estimation of resources and services flow. Based on those outputs, the research programme should also encompass social valuation / social contextualisation and certification; economic valuation; and scenarios for sustainable development.

A Biodiversity 'Stern' report: beneficial or counterproductive for biodiversity conservation in the wider countryside

Klaus Henle, Session I Chair

Summary: The Potsdam Initiative launched last Friday announced, inter alia, a biodiversity 'Stern' report. I argue that there is a fundamental difference to climate change that needs to be taken into account to make such a report beneficial and not counterproductive to biodiversity conservation in the wider countryside.

At the recent summit of Environmental Ministers for the preparation of the G8 meeting, the Potsdam Initiative was launched last Friday and, inter alia, a 'Stern' like report for biodiversity was announced. I briefly discuss these two issues in the context of our current discussion of biodiversity conservation in the wider countryside.

Most of the contributions to our discussion stressed the need to take a holistic approach for biodiversity conservation in the wider countryside but the opinions about economic approaches and research needs to biodiversity differ. For example Jan Jansen calls for research to re-examine the economic possibilities of farming in marginal areas whereas Richard Hardwick argues that there has been already sufficient research on this topic.

The idea of a 'Stern' report may take a position in-between, since a report would not be feasible without considerable knowledge of the economy of biodiversity use and conservation in the wider countryside but the knowledge certainly is insufficient to fully understand the economic consequences of biodiversity across the whole wider country side. Considering what may be the consequences for research priorities of the launching of such a initiative, I first argue that there is a fundamental difference to a report of the economic consequences of climate change. Whereas human economic activities can go on under any climatic scenario – with different costs and benefits – human life is part of biodiversity and thus ultimately no human endeavour, no economic activity would exist without biodiversity. Furthermore, there are non-utilitarian issues involved in biodiversity conservation and this applies especially to the wider countryside without which we cannot preserve many of the high profile components of biodiversity, such as large carnivores.

Having this fundamental difference in mind I argue that the priority of a report and supporting research should not be an attempt to generally quantify biodiversity and biodiversity loss in economic terms. A mainly economical approach may be suitable for assessing the value of natural resource use (e.g. medical plants, wildlife trait, ecotourism) and the economic consequences of biodiversity loss for these economic activities but will short fall for many other issues. My impression is that biodiversity conservation in the wider (European) countryside by natural resource has not seen sufficient research and review and should be one future research priority. Such a priority must be complemented by research that develops strategies how the conservation of biodiversity can contribute to the cultural, social, and general well being of the people living in and of the wider countryside. Research and a report should contribute to making available examples of best practice and to answer the question how could such a wider countryside look alike in the future and what type of wider countryside do we want to have and which we want to avoid?

Human Induced Climate Change vs. Biodiversity Loss: Comment on Klaus Henle

Clive Spash, CSIRO, Sustainable Ecosystem Division, Australia

Klaus Henle raises the issue of a Stern type report on biodiversity and wishes to reject it. I agree that it should be rejected but not for his reasons. I find his arguments flawed.

Klaus states that climate change is different from biodiversity loss and this is why a Stern report cannot be conducted. In fact the two questions are confusingly intertwined. However, lets leaving that aside for a minute. He points to the important differences being (i) "human economic activities can go on under any climatic scenario"; (ii) "there are non-utilitarian issues involved in biodiversity conservation" implying there are none in climate change. He is wrong on both counts.

On point (i) Humans survive in a narrow range of temperatures; we live on Earth not Mars or Mercury. We live on that bit of Earth which is not water, not too hot and not too cold. Climate change threatens to raise sea levels, increase temperatures and increase variability creating more and larger extreme events. Human induced climate change is a threat to many species on this planet. Scientists should not belittle the impact of human potential to change climate; there is a real and growing threat that we will eradicate life as we know it via enhancing the greenhouse effect, and a least the human part.

On point (ii) both human induced climate change and biodiversity loss involve a range of values. Modern economics employs a very specific form of utilitarianism, namely preference utilitarianism. This tends to ignore a whole range of other values and other value systems. For example the rights of future generations or justice for the current poor. Both of these non-utilitarian values are involved in climate change.

Let me return to the point concerning the interactions between biodiversity loss and climate change. As biodiversity is also threatened by climate change it is then actually a subclass of impact under climate change, although its loss is not simply prevented in the absence of climate change. However, climate is not, as far as I know, threatened by biodiversity loss in the same way. Thus values impacted by biodiversity loss will be impacted under climate change which also contributes to that loss.

As to reasons for avoiding a Stern report approach they are many and diverse. The initial response I have is why do you want to do this: science or politics? Do ecologists just want some big numbers to impress their friends? That seems to be the pragmatist game, but it has little to do with science or economics. Stern, like all global cost-benefit analyses, is in seriously in trouble on both counts.

What exactly are you trying to do: measure a total value, measure a change, if so what change? The total value is infinite so there's no point going down that route. We've already had a bunch of meaningless numbers on valuing ecosystems and all they achieved was to put progress on getting better decision tools into the policy arena back 10 years. Suddenly the numbers game is the only one in town whereas progress was being made on multi-criteria approaches, participation and direct legislation (to name a few alternatives).

If you are considering changes then you are into scenarios and the future is full of them. What is your status quo? What does the future hold? Stern randomly chose 4 scenarios to do some simulations. Why? Why these 4? The IPCC had some 40 or so. What is the point of admitting uncertainty and ignorance and then jumping onto a few

scenarios and then jumping again to a single aggregated GDP number? As Stern admits these numbers can even be compared across scenarios as there is no basis for comparison.

What measures are you going to use, over what time period and why? Stern went for a cost-benefit approach which confused language by referring to costs for both categories and criticised other studies measures but then used a similar one. GDP is a bad measure of human welfare let alone well being so why use that? Simple it supports the establishment and this was a government report. If you want to measure human well being then you are going down a human development index type route not a Stern monistic monetary measure based on preference utilitarianism. As to the time period Stern used an arbitrary 200 years cut short by consumption discounting assumptions.

These are just some basic questions before you even start looking at all the problems which exist with Stern and more generally for monetary valuation. For some indications of those see (Spash, 2002; Spash, 2007). The more recent is available for free download on www.clivespash.org.

Stop and think for a second. How can economists predict a 200-year planetary future? How did all those catastrophic and uncertain events suddenly become known bounded probability distributions with fixed damage ranges? What did any of this really achieve in scientific terms?

I would just point out that Stern offers a business a usual approach. This is a pro-growth document published by the UK government, which is seeking re-election in the near future and has a pro-nuclear energy agenda. Stern is not the driver of change but is rather the output of a political process. You might want to reflect upon the history of greenhouse gas control and see how economic valuation has generally been used to reduce policy action not to implement mitigation. We are still on business as usual after 20 years and by the way a similar report was published 15 years ago by Cline and this also calculated damages at 20% GDP; so how effective was that?

Cost-effective conservation in rural areas

Frank Wätzold, Helmholtz Centre for Environmental Research, UFZ, Leipzig-Halle, Germany

Summary: The author highlights three areas where research on a European level is particularly needed to improve the cost-effectiveness of agri-environmental schemes

Knowledge of what cost-effective conservation means is often poor among conservationists, policy makers and representatives from research funding bodies. It is frequently being confused with Neoliberalism and optimality (which means costs and benefits of biodiversity are being balanced to find an optimal level of conservation). Some people also seem to confuse it with cutting money allocated to conservation. It is none of it, it just means spending the available money in a way where conservation is maximised. This is an important issue in conservation in rural areas in Europe where each year billions of Euro are spend on agri-environmental programs with – at least partly – disappointing results for conservation. One reason may be a lack of knowledge on how to design programmes; another reason may be that the primary interest of many agricultural administrations in such programmes is to improve the income of farmers. In the following I will highlight three areas where I believe research on a European level is particularly beneficial to improve the cost-effectiveness of agri-environmental schemes:

Decision support tools for designing cost-effective agri-environmental schemes: There has been some research on how to design cost-effective agri-environmental schemes but this needs to be further developed into decision support tools to make it fruitful for conservation in practice. I only know of one software tool (developed in the context of the EU-MacMan project and based on an ecological-economic modelling procedure) which allows a conservation manager to readily compare the effects of various management measures on the survival of the Large Blue butterfly for given budgets in a small region in Rhineland-Palatinate, Germany. Such tools should be developed for multi-species conservation and on a much larger spatial scale. It would give conservation managers a powerful argument if they could demonstrate with such a tool to agricultural administrations that certain agri-environmental programmes have no or only a limited effect on conservation.

Comparative research identifying best practice: In Germany, one example of a successful agri-environmental programme is the MEKA-Programme in Baden-Württemberg where farmers are rewarded for results (when certain endangered plants appear on their field) and not for measures (as with nearly all other programmes in Germany). The program is appreciated by farmers and conservationists alike because it provides income and tangible benefit for conservation at the same time. Knowledge about this and other successful examples of conservation in agricultural landscapes should be gathered, analysed and spread to promote best-practise in the EU.

Improving institutions and governance structures: Anecdotal evidence reports that many problems leading to a lack of success of agri-environmental schemes are a result of badly designed institutions and governance structures (understood here as administrative and legal rules related to design and implementation of agri-environmental schemes). For illustration consider an example: EU monitoring and enforcement rules for agri-environmental schemes focus on controlling whether the

size of farmland participating in a scheme is correctly reported to the administration. This is, of course, one aim of monitoring but much more important is the (neglected) aim of controlling whether programs actually improve conservation. Research needs to investigate how institutions and governance structures have to be designed to ensure that the available money is spent in the interest of conservation.

Wildlife conservation through sustainable use: research needs

Herbert Prins, Resource Ecology Group, Wageningen University, The Netherlands

Summary: Shrinking human populations, especially in the countryside, leads to an unparalleled rebound of wild animals, which can be sustainably harvested.

Europe undergoes rapid changes, especially demographically. Its city population still expands but its rural population declines. Some European countries even face population shrinkage, such as Germany and Italy. This contraction is most notable at Europe's eastern flank: Russia's population is expected to fall by 22% between 2005 and 2050, Ukraine by a stunning 43%. Superimposed on this is the depopulation of the countryside, which happens in all temperate countries, from New Zealand to Argentina, Japan, Canada, the USA, and the whole of Europe and former USSR. In the past decade, some 13,000 of Russia's 155,000 villages were abandoned and 35,000 are now populated by 10 or fewer people, many of them old. Although the reduction in agricultural lands started in the 1980s, the loss between 1990 and 2001 in the Russian Federation was close to 10% in land surface: since 1970 some 25 million hectares reverted to wildlands. Russia's Far East is rapidly depopulating but so are Nova Scotia and other parts of Canada's hinterland.

In Europe, most changes take place in mountainous areas. For example in France the number of farms declined from about 880,000 in 1950 to 220,000 in 2005. Poor, hilly areas in France, Italy, Spain and Portugal lost more than half their active population since the 1970s. In the north of former East Germany, between 1991 and 1997 the number of people working in agriculture declined from 296,000 to 164,000. In "Old Europe" (the European Union of 10 countries), the utilized agricultural area diminished by more than 3 million hectares between 1975 and 1987; between 1980 and 1990 this was 1,251,000 ha in Germany, 1000,000 ha in France, and 307,000 ha in Italy. The surface areas of permanent meadows and grassland have strongly declined in "Old Europe" too (between 1980 and 1990 1 million hectare).

New wilderness emerges in southern Europe and the vast lands from Germany towards Vladivostok. The seashore of the Mediterranean is used heavily by tourists but behind the coast forests are spreading. Agricultural abandonment, in countries such as the Ukraine, following the collapse of the Soviet Empire is leading to bush. In these new wildernesses there is an astounding growth of wild large animal populations, most noticeably roe deer and boar but also elk (moose) and wolf. At present there are more wild ungulates in Europe than there have been for some centuries!

From this a research agenda emerges:

(1) We need reliable maps of the new wildernesses,
(2) We require insight into "old field succession" on these lands,
(3) We have to understand the ecological requirements of the rebounding wild life,
(4) We must have insight in the demographic patterns concerning human population decline and land abandonment,
(5) We need insight in the population dynamics of the wild animals that benefit from abandonment,
(6) We have to study the economic and financial possibilities of sustainably harvesting these wild species,

(7) We have to study the effect of harvesting on animal well being and impact on the vegetation.

Tourist destinations increase urban sprawl, but do we know their impacts on nature?

Jukka Jokimäki, Arctic Centre, University of Lapland, Finland

Urbanization is a large-scale process that fragments the landscape and impacts negatively on the distribution and abundance of many native species. Some species may be considered as urban exploiters, others as urban avoiders or suburban. Urban avoiders fail to successfully reproduce and may become locally extinct in urban landscapes, whereas urban exploiters reproduce successfully in urban habitats and colonize new locations. Invasions by these ubiquitous species and decrease in the numbers of ground nesting species may cause general homogenisation of biota. Therefore, it is important to know where urban growth will occur and what the biological impacts of the urban sprawl are.

The increase in people's leisure time has indirectly increased the extent of urban sprawl. New summer cottages and tourist destinations have been established in areas formerly undisturbed and areas with old cottages and ski resorts have expanded. Cottages may change e.g. the bird community structure and the occurrence and abundance of nest predators. In general, this kind of urban sprawl may be especially harmful to the ecosystem because it is directed towards wilderness areas.

More information about the effects of the urban sprawl caused by tourist destinations is needed and this information would be valuable for planners involved with tourist destination area. However, only limited studies of environmental impacts of recreation and tourism on nature have been published. The results of these recreational oriented studies have shown that e.g. bird species composition has been altered adjacent to recreational trails and generalist species are more abundant near trails. We need to know how severe the disturbance caused e.g. by ski resorts on animals is and whether this type of urban sprawl is comparable to traditional urbanization processes in towns.

A typical feature of ski resorts is the seasonality in the numbers of visitors. The numbers of tourists may increase 5-fold during the peak skiing season as compared to the summer season. Another feature that sets ski resorts apart from towns is the low number of permanent local residents living in these destinations. Tourists need services, e.g. hotels, shops, fireplaces, camping places, etc., and these services must be planned based on the peak season figures.

Dr. Prins pointed out in his keynote contribution that the number of farms etc. has decreased in some parts of peripheral Europe. However, as we all know, the situation is not the same all over the Europe. Therefore, we should avoid doing false generalizations. For example, villages located near attractive natural areas, e.g. near the Natura 2000 areas, have increased heavily their attractiveness in northern Scandinavia. People are seeking more and more areas with minimal impacts of human disturbance when deciding where to spent their holidays. In addition, the "new tourists" as well as the companies offering services for the tourists are quit well aware of the environmental topics.

However, we almost totally lack information on how tourist destinations affect on nature, how we could monitor the effects of their effects on nature and what will be the suitable indicators to monitoring the change. Apparently these indicators should include variables that contain ecological, sociological, economical and cultural indicators. It is very important to start to monitor the effects of tourist destinations on

the nature and develop suitable indicators to monitor the effects of tourist destinations on nature. This is especially important because most of the tourist destinations, otherwise than towns, are located near the attractive and valuable natural areas.

Some tourist destinations are nowadays like towns, expect that the number of people in these sites per area might be even higher during peak seasons and some tourist destinations are almost empty of people during other seasons. However, the infrastructure in these tourist destinations is still there outside of the peak tourism season and the capacity of infra is planned according to the peak seasons. In addition, most presently attractive tourist destination have plans to at least double their visitor numbers. At the present, we do not know almost anything about this type of seasonal disturbance on the nature. Our EU LIFE Environment founded project, LANDSCAPE LAB (www.arcticcentre.org/landscapelab) has taken the first steps in this road. Our preliminary results of the project have shown that the nature within tourist destinations differs from their surroundings and they have some remarks that resemble the nature in real towns. Apparently, tourist destinations have impact on their surrounding nature, and the surrounding areas may have corresponding effects on the nature living in tourist destinations. Surely, more information is needed to understand more deeply the interaction between the tourist destinations and their surrounding wildernesses. Therefore, our project is organizing an international conference dealing with the relationship between the nature and tourism in May 2007 in Rovaniemi, Finland.

RE: Tourist destinations increase urban sprawl, but do we know their impacts on nature?

Morad Awad, NIOF, Alexandria, Egypt

The Red sea coral reef and its habitants of living organisms have been subjected to severe damage over the last 20 years because of continuous shore line and coastal urbanization that are extending and covering great areas by using sand and rock filling in the near and coastal water. This is to establish hotels, tourist villages and marinas in favour of lateral development and revenue of tourism, regardless of the coral reef and its benefits.

An important question is how to recover such huge damage? I think coral reef culturing is now of prime importance to start amending such a situation. This needs a great effort to convince official people to start thinking of how to recover such ecosystems. Coral reef culturing must be established and promoted by formal and/or informal organisations. NGOs should have their own programs of awareness concerning such an issue.

Needs of the national policy maker

Andrew Stott, Living Land and Seas Science Division, Defra, Bristol, UK

Summary: The main constraints to delivering this large and complex research agenda are lack of resources, institutional barriers and ineffective knowledge transfer. We need to make more effective use of available resources by better prioritisation and co-ordination. We need to create better incentives for multi- and trans-disciplinary working. We need to strengthen the interface between science and policy and develop better tools for accessing and sharing knowledge.

Defra's research concentrates on what is needed for developing a policy framework, evaluating policy options and for the implementation of the Department's legislative and regulatory functions (see Box 1 for more background).

Box 1 Background to Defra objectives and science

The Department for the Environment Food and Rural Affairs (Defra) is the UK Government Department responsible for development of biodiversity policy in England and leads internationally on biodiversity issues for the UK.

Defra is currently renewing its overall strategy and within an overall mission of 'One Planet Living', the new strategy will have two high level goals:

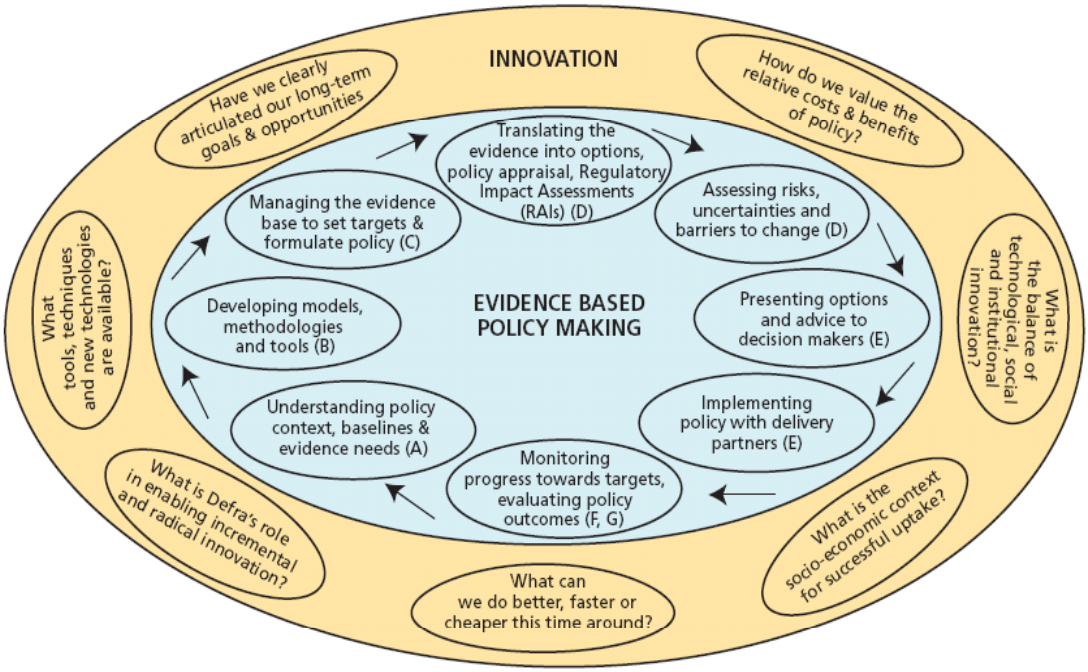
Leading the global effort to avoid dangerous climate change through shifting economies to a low-carbon basis, starting with action in the UK
Secure a healthy natural environment for everyone's well being, health and prosperity, now and in the future, and reflect in decision-making the value of the services that it provides.
Biodiversity and the 2010 target is included in the second goal and one of the measures of the success of the strategy will be the outcome for biodiversity as shown by a headline indicator of trends in wild bird populations in England.

Defra spends around €6 million per year on research related to biodiversity in the wider countryside including research to support development of agri-environment policy, wildlife management and long term monitoring. However, this represents only about 4% of Defra's overall RandD budget.

Defra also relies on research and surveillance programmes of its delivery and advisory bodies in particular: Natural England (formerly English Nature), the Environment Agency and the Joint Nature Conservation Committee (JNCC).

Defra's Evidence and Innovation Strategy sets out a general framework for evidence based policy making and identifies where science is needed at different stages (A-G) in the policy making cycle ranging from understanding the baseline situation, to exploring policy options, improving delivery and monitoring outcomes (see Fig 1).

Figure1. Defra's Evidence Based Policy Model



Source: http://www.defra.gov.uk/science/how/strategy.htm

The main research needs as we move around this cycle are:

(A) We need better baseline information on status and trends in biodiversity in the wider countryside. We need more integrated management and analysis of environmental and socio-economic data so that we can assess ecosystem services. We need sample-based surveillance (e.g. UK Countryside Survey – see Box 2) and improved networks for detection of long-term environmental change. We need to be able to detect and assess the impacts of climate change on biodiversity and ecosystem services.

(B, C) We need to continue to develop methods and tools for formulating biodiversity policy and targets, recognising the dynamic global economic and environmental situation. This will include: developing and testing policy relevant indicators; improving understanding of the relationships between biodiversity, ecosystem functions and goods and services; predicting the likely future impacts of climate change; assessing the social and economic impacts of biodiversity change; and measuring our ecological footprint.

(D, E) We need to improve decision methods including cost/benefit analysis, risk assessment and participatory processes. We need to test the practical application on an ecosystem approach. We need to explore and evaluate options for adaptation to climate change, for example how to increase resilience within managed ecosystems. We need to improve the evidence base for targeting and effective implementation of agri-environment schemes (see Box 2).

Box 2 Further examples of Defra science programmes for sustainable agriculture and biodiversity

Countryside Survey
Countryside Survey is a scientific study aimed at detecting changes in the natural environment, including the impacts of short-term policy changes such as agricultural policy resulting from CAP reform and the longer-term ecological impacts of climate and air pollution. The Survey involves a random sample of 1 km squares which have previously been surveyed four times since 1978. The overarching objectives are:
To record and report on stock, condition and extent of Broad and Priority habitats, landscape features, vegetation, land cover, soils and freshwaters in the countryside of GB, England, Scotland and Wales;
By comparison with data from earlier surveys, to assess changes in the countryside and improve our understanding of the causes and processes of change;
To collect, store and analyse data in ways that optimise the integration of Countryside Survey data through time and extracts added value from other data sources; including the Northern Ireland Countryside Survey to enable UK level reporting.
To provide access to data and interpreted results that underpin a range of policy and science needs for major environmental zones and landscape types in the UK, GB, England, Scotland and Wales.
To contribute to the development of an integrated assessment of the drivers and pressures of change and better understand their effects on the UK countryside and, their implications for ecosystem goods and services.
(See: http://www.nerc.ac.uk/publications/planetearth/2006/winter/win06-countryside.pdf)

Evidence base for agri-environment schemes
Research on agricultural grasslands will address management practices to improve botanical diversity, mitigation of predation impacts on wader birds, management of unimproved grasslands, and the enhancement of grasslands for invertebrates and birds, particularly in relation to improving structural heterogeneity. Arable farmland research will continue to test in-field and field margin enhancement to benefit farmland birds and invertebrates. Collaboration with industry is being encouraged through Sustainable Arable LINK projects. Research will also be required on upland issues, for example, grazing impacts on vegetation communities, bird populations and farm profitability.

The Environmental Stewardship (ES) Monitoring and Evaluation programme is designed to provide evidence regarding the performance of ES - to inform future development of agri-environment policy and improve the delivery of ES objectives. Much of the early evaluation effort has addressed the scheme operation and processes, assessing the likely "success" of ES and modelling the delivery of scheme objectives. In future the emphasis in the evaluation of ES will shift to assessing outcomes, facilitated by the clear emphasis in ES of defining the features to be managed at the outset of each agreement. (See: http://www2.defra.gov.uk/research/Project_Data/projects.asp?SCOPE=0andM=PSAandV=EP%3A150)

Agriculture Change and Environment (ACE) Observatory
Defra's ACE Observatory aims to monitor and improve understanding of current and future changes in farming patterns and practices as a result of CAP Reform and other key drivers; improve understanding of links between changes observed at farm level and observed environmental changes; and assess future environmental changes based on analysis and understanding of causal links. See:
http://www.defra.gov.uk/farm/policy/observatory/index.htm

(F, G) We need to monitor and evaluate the outcomes and impacts of our policies at national, regional and global levels to assess progress towards 2010 targets. We need to improve methods for integrated ecosystem assessment. We need to be able to measure the outcomes of particular instruments, such as CAP reform and regional development (see Box 2)

With regard to innovation, we need to develop more cost effective methods for surveillance of biodiversity using methods such as citizen science, earth observation and DNA markers. We need to continue to develop innovative methods for sharing information for managers and policy makers. We need to explore new policy options including market creation in biodiversity, developing incentives for biodiversity such as biodiversity offsets, and valuation of ecosystems services.

Intensive husbandry, extensive farming and new wilderness

Jan Jansen, Radboud University Nijmegen, the Netherlands

European society has passed through several changes (e.g. Roman Empire, French Revolution, Industrial Revolution). All of these changes had profound impacts on landscapes and how they were perceived and used. The landscapes that we experience today are therefore the result of a complex chain of historical developments. In many instances, the factors in question no longer operate or operate in ways quite different to those that pertained when the cultural landscape was originally created. Now we are in the Global Revolution era.

Early peoples regarded the universe as an orderly system in which they, as individuals and societies, had a role that was part of, rather than above, the natural order. People regarded themselves as a part of nature rather than as being opposite to, or independent of, nature. The relationship was one of mutuality that bound together people, nature and the gods in a complex and interdependent whole. This involved use of natural resources, taking no more than living required and guided by a complex of prescriptions and taboos.

In contrast to the above, our societies generally tend to regard people/nature relationship as to physical matter. Arising from this is the major concern of how to control nature and how technology can be applied in the interests of material comfort. The vast majority is not concerned with the intrinsic value of other peoples, plants or animals; instead, society's main concern is with exploitation of natural and physical resources.

Would the calculating not mainly come from the utilitarian attitude to nature and our living planet? In natural and semi-natural ecosystems there is certain balance; as there was in our traditional landscapes in the wider country-side. In modern economy farmers just fade away and do not come back under the circumstances but as industrialists. Here the circle is not round like in most traditional land use.

Earlier I asked attention for the last farmers in Portugal. At present we can suddenly consider them excellent managers of several EU Directives. That is an utilitarian approach...for the sake of humans and nature. However we cannot do without intensive husbandry. We grew from ca. 1 billion people in 19th century to 6 billion now. If we were to go back entirely to more traditional farming we would have a problem to feed the people. The number of people should go down. But that message is taboo. Dr. Herbert Prins showed that Europe undergoes rapid changes, especially demographically. Should economics propagate growth or balance?

Would it be a good idea to concentrate intensive husbandry in certain areas and other larger areas for extensive farming and "new wilderness"? In the wider countryside I see complex land-use changes provoked by demands from "markets". Why would economists not focus on the wider consequences and why would ecologists not try to understand the complex socio-economic interactions? Here are two fields of priority research.

Tradable Permits for Biodiversity: Alternatives for existing conservation policies?

Silvia Wissel and **Florian Hartig**, Helmholtz Centre for Environmental Research, UFZ, Leipzig-Halle, Germany

Summary: Tradable permits offer an alternative to existing policies for biodiversity conservation in fragmented and heavily used landscapes.

In hitherto existing biodiversity conservation policies, the focus of decision makers has been predominantly confined to static protection measures and conservation payment schemes. Despite encouraging progress in particular cases, many of these measures have displayed considerable flaws in their design, some leading to ecological ineffectiveness, others to unnecessarily high costs or to acceptance problems. Given that we are far from reaching the 2010 target of halting the loss of biodiversity, new instruments are urgently needed to address these problems and induce increasing conservation on agricultural and open lands.

Instruments that have been proposed and successfully applied in other areas of environmental policies are tradable permits (TPs). In a TP market, land developers are obliged to compensate for ecological losses caused by their impact (similar to the Impact Mitigation Principle, Germany), creating demand for TPs, which are supplied by landowners grading up the ecological value of their land. Alternatively, a market can be implemented where the policy-maker sets an environmental target, obliging each landowner to maintain a certain fraction of his land for conservation purposes (similar to Brazil Forest Trade). Landowners conserving more land receive permits, which they may sell to those who conserve less.

Tradable permit markets offer more flexibility and higher cost-effectiveness as compared to static measures. A decisive element of the market is which criteria are taken into account when issuing permits and which rules apply for their tradability. It is a prior challenge to condense the heterogeneity and spatial dependence into a simple and homogeneous value which can be traded on a market.

Requirements for homogeneity and simplicity, however, are often in conflict with ecological necessities, demanding for local and individual considerations. It is therefore vital to include sound ecological background for the rules according to which permits will be handed out and are allowed for trade. For biodiversity the spatial allocation of measures is a crucial factor and must be incorporated into the issuance of permits.

Practical experiences with TP systems as well as the present state of academic research are widely confined to systems which do not incorporate the spatial context of TPs. A better understanding of these markets is therefore urgently needed to decide whether they provide a more effective policy instrument for biodiversity conservation and sustainable usage of landscapes.

Taking into account the interdisciplinary context, the EcoTRADE project, funded by the ESF, studies TP markets from three perspectives. An economic analysis examines conceptual issues, existing systems and possible market designs. From the ecological perspective, impacts of trading activity are estimated. The approach is completed by ecological-economic simulations, studying the interactions of individual actors and the ecosystem under different trading rules.

Further research is needed to analyze the interactions of human behaviour and ecosystems. Ecosystem values need to be represented in decision-making by policy makers and individuals. To understand the impacts of different policies integrated research between social and natural sciences is required. Methodologically, ecological-economic simulations can serve as a platform to examine and discuss different scenarios and policy designs.

Re: Tradable Permits for Biodiversity

Sergio Peña-Neira, Bren School of Environment, Santa Barbara, USA

First of all it is a very interesting idea. The Convention on Biological Diversity has used the ideas of conservation, sustainable use and utilization of these resources (genetic or biological) in the way you are putting forth.

Secondly, such an idea (sharing benefits) has been developed and implemented in some developing countries and other countries rich in biodiversity as a tool for financing conservation of biodiversity. Of course, parallel to this idea of tradable permit you can implement a whole system of utilization of Natural Genetic Resources (a topic that I will send a short article to contribute to this discussion).

Thirdly, tradable permits for biodiversity, however, might be possible in European countries with a strong commitment to developing protection and conservation of biodiversity taking into account the loss of biodiversity in a very long period of time as a consequence of the industrial revolution. Comprehension of such a topic is extremely important.

Fourthly, so far, such a system has been considered in various areas like those related to Climate Change and particularly pollution of the air. Actually I know a European commercial bank that has a division that works on this issue.

However, there are certain questions to put forth, for example who would be the stakeholders of the benefits arising from the permits? Will there be an equitable share of these benefits? What about the problem of those that have property rights over lands? Should they ask for a payment or there will be a distinction on rights over the land and rights over the genetic resources, the biological resources and others?

I hope to send a short contribution because I have written on this subject matter (sharing benefits and access to genetic resources related to biological diversity either in Spanish, English and German). This could be of interest for all of you.

Re: Tradable Permits for Biodiversity

Clive Spash, CSIRO, Sustainable Ecosystem Division, Australia

For anyone interested in the other side of tradable permit markets they may like to look at the references below:

Bond, P. and Dada, R (Eds.). Trouble in the Air: Global Warming and the Privatised Atmosphere. Centre for Civil Society (South Africa) and Transnational Institute (The Netherlands), www.thecornerhouse.org.uk/pdf/document/trouble.pdf

Lohmann, L. (2006) Carry on polluting. New Scientist: 2nd December p.18

How can agri-environment schemes contribute to reaching the 2010 target in the wider countryside?

David Kleijn, Alterra, Centre for Ecosystem studies, Wageningen, The Netherlands

Summary: Agri-environment schemes should be regarded as working hypotheses that need constant adjustment to optimise their ecological effects.

Agri-environment schemes are arguably the most important tool for biodiversity conservation in the wider countryside. On the 30th and 31st January 2006 ecologists involved in the design, implementation and evaluation of agri-environment schemes (AES) throughout Europe came together in Wageningen to exchange their experiences with the effects of agri-environment schemes on biodiversity. They concluded that AES do not currently adequately protect farmland biodiversity at a European or national scale. They also concluded that there are enough examples of individual schemes which do protect biodiversity to suggest that, given correct evidence base, design, targeting and funding, AES could provide adequate protection for biodiversity.

Available evidence so far indicates that schemes aiming to increase biodiversity in general, for example with the objective to improve ecosystem processes such as pollination or pest control or to increase the value of agricultural landscapes for leisure activities, may be successful even when prescriptions are general and farming is relatively intensive. Schemes aiming to promote specific endangered species on the other hand probably need to be much more tailored to the needs of these species and need to account for environmental factors, such as dispersal barriers or groundwater level, that are outside the control of farmers but nevertheless constrain the effects of their conservation measures. It is important to note that this knowledge is largely based on studies carried out in intensively farmed areas and ecological information on the impacts of schemes on land abandonment and the associated biodiversity implications are largely lacking.

Agri-environment schemes should be regarded as working hypotheses that need constant adjustment to improve effectiveness and account for changes in agricultural practices and climate. To be able to do so AES need clear objectives and targets. These objectives and targets should be area-specific, realistic and quantitative in terms of changes in abundance, range or diversity of specified species or species groups and be time delimited. In general, there is sufficient ecological insight and geographical information to identify the objectives, outcomes and targeting for potential AES prescriptions. However, ecological insights are often lacking for spatial scale effects and for temporal and ecosystem service effects. Wide-scale ecological evaluations, well-integrated in scheme design and implementation, should be linked to specific case studies on the causes of effectiveness of lack thereof. Ecological insights into cause and effect are important for the design/re-design process, for which monitoring and clarity of objectives are key.

Only such an approach, integrating the formulation of objectives and targets, the implementation and the evaluation of schemes, can be easily linked to the 2010 targets in the wider countryside. Successes and failures can than be identified and used to improve scheme design and implementation and ultimately to contribute to reaching the 2010 targets.

Re: How can agri-environment schemes contribute to reaching the 2010 target in the wider countryside?

Jan Jansen, Radboud University Nijmegen, the Netherlands

You wrote: “Wide-scale ecological evaluations, well-integrated in scheme design and implementation, should be linked to specific case studies on the causes of effectiveness of lack thereof. Ecological insights into cause and effect are important for the design/re-design process, for which monitoring and clarity of objectives are key”.

I fully agree with you. It would be interesting to compare for instance a few extensive heathland-based farming areas in Serra da Estrela and others in Portugal which are far behind in temporal scale and that lie in a potentially more or less equal kind of biodiversity-landscape with similar potential landscapes (wide-scale: former heathland-based farming areas on sandy soils) in NW-Europe that are ahead in the time-scale, e.g. Veluwe, Netherlands; e.g. Lüneburger Heide Germany. Restoration ecology is booming in the latter countries!

Because the Estrelean territory was isolated and disadvantaged, there is still a chance to offer products and services that could hardly be maintained and can hardly be restored in other former heathland areas in Europe. Whereas the ones in Portugal still have high biodiversity due to the newly identified managing skills of the traditional farmers and OK the lack of production subsidies, the areas in the Netherlands and Germany often receive or received high amounts of subsidies to raise production and now in addition to restore biodiversity.

Heathland-based farming in combination with new activities may in some cases constitute a sustainable socio-economic basis for maintaining and improving the scenic quality of landscapes, and conserving its biodiversity, genetic crops and breeds and other cultural values.

Linking wide-scale ecological evaluations to case studies could reveal specific situations that merit investment in subsidies. Interesting to see the cost benefit outcome in terms of social, economic and ecological capital.

Research contributions to reaching the 2010 target in the wider countryside: Memories of the Future?

Jan Plesník, Agency for Nature Conservation and Landscape Protection of the Czech Republic

Summary: Research which could contribute to reaching the 2010 target has been facing two problems: (1) continuing and for some components even accelerating rate of biodiversity loss and therefore, extremely urgent needs to implement effective measures to reverse this trend, and at the same time (2) insufficient knowledge of status, changes and trends in biodiversity at all the three main levels. The author identifies a number of research needs to counter these difficulties.

Because biodiversity-related questions are complex and interlinked, they need new research approaches and a greater degree of multi- and interdisciplinarity in research and technological development (MA 2005, Groom et al. 2006). In relation to biodiversity management, some fundamental questions in ecology, conservation biology and environmental science should be answered by researchers (e.g. relationship between biological diversity and ecosystem functioning, carrying capacity thresholds and patterns in main ecosystem types, biological/ecological integrity concepts, widely acceptable habitat/ecosystem/land-use/landscape types classification, realistic assessment of ecosystem goods and services values, etc).

Scientists, at least some of them, often study attractive, often unique wildlife species, habitats or whole ecosystems. Due to main land-use patterns in Europe (EEA 2005, 2006), the same attention should be paid also to current common ones, occurring in farmland, forests and human settlements (Clergue et al. 2005). This is even more relevant to the wider countryside than to protected and other specially designated areas.

Analysing biodiversity changes, drivers and pressures in order to gain understanding of possibilities to influence these should take into account the synergy effect of various anthropogenic and natural drivers of biodiversity changes, e.g. habitat fragmentation, destruction and loss; and climate change (Gitay et al. 2002, Travis 2003). For assessing status, changes and trends in model components of biological diversity in the wider countryside, a reasonable monitoring scheme based on the agreed baselines and standards (Yoccoz et al. 2001) at the European level is needed. Developing an accessible Europe-wide geo-referenced inventory of species, ecological/functional group and habitats to better understand and assess their distribution status, changes and trends will also significantly contribute to reaching the 2010 target.

At the European level, a research infrastructure for the integration of data, methods and scientific communities is necessary to complement national efforts, as knowledge and science-policy interfaces are essential to support the decision-making process (EPBRS 2006). The role of biodiversity and natural resources management in recently emerging issues, e.g. climate change, energy, food and water security, urbanisation incl. urban sprawl, etc should be studied in more details.

The main challenge does not lie in the identification of new and more and more research topics, but in the establishment of research agendas and research environments that address biodiversity issues from really multiple and innovative

angles, leading to the reframing of problems related to the biodiversity changes across Europe. The 7th European Community Framework Programme for Research and Technological Development (2007-2013) should meet some of the above issues.

Achieving the objective of halting biodiversity loss in the wider countryside – how to measure effective cross-sectoral integration?

Rainer Müssner, Ecologic-Institute for International and European Environmental Policy

Summary: The author explores the existing integration of biodiversity in sectoral policies and recommends research on methods to evaluate the relative success of integration of biodiversity concerns in sectoral strategies, including the development of relevant indicators as well as research to enhance the effectiveness and efficiency of SEA/EIAs.

The integration of environmental concerns in sectoral policies, like agriculture, forestry, infrastructure planning or transportation, the so-called Cardiff-process, is an important aim of the 6th Environmental Action Programme (COM 1998). The integration of biodiversity concerns in sectoral policies is a necessary pre-condition to conserve and restore biodiversity and ecosystem services in the wider EU countryside (objective 2 of annex to COM 216). Outside protected areas conservation faces particular challenges, that differ considerably compared to those inside designated areas. In the wider countryside biodiversity conservation is at best a secondary objective, that is taken into consideration if it doesn't compromise too much the main focus / interest of the landowner / land user.

Hence, chapters 4.2.2-4.2.5 of the communication deal in particular with the challenge to achieve a better integration of biodiversity in sectoral policies. In many policy areas specific measures exist that should help or even guarantee effective and efficient integration (e.g. Agri-environmental schemes in the CAP). Nevertheless, being aware of the current gaps and deficiencies, the authors of the communication quite often used conditional clauses like "if implemented" or "if implemented properly".

The annex of the above mentioned communication outlines 24 actions to be undertaken by the EC and its Member States to achieve the objective set on the policy side. The role of the EC (community level action) is mainly to evaluate and assess the level of national implementation and encourage better integration or adjustment of measures. Nearly half of all community level actions are defined as "providing guidance". This is not surprising because the responsibility for the implementation of the policies lies in the hands of the Member States. Their role is to identify and implement the necessary measures.

But what is the real level of integration in sectoral policies? How is biodiversity taken into consideration when it comes to on the ground decision-making? This is far from being routine or an easily to perform investigation. It goes far beyond simply measuring the results of policies in number of species, habitats or quantities of ecosystem services provided in a particular countryside.

Of course there is no regional or national development plan that doesn't include the terms "sustainability" or "biodiversity" and of course we have the Environmental Impact Assessment (EIA) and more recently the Strategic Environmental Assessment (SEA) to avoid negative implications for biodiversity. However, the authors of the communication come to the conclusion that EIAs are often done too late or are of poor quality and the SEAs apply only to certain plans and

programmes while others are excluded. But as a matter of fact, we haven't been able to stop biodiversity loss in our countryside yet. Results from studies undertaken some years ago (IEEP 2001, 2002) came to the conclusion that there are no clear indicators that biodiversity concerns were effectively integrated or the state of implementation is unclear.

The environmental outlook from the European Environmental Agency gives a mixed picture of the level of integration in different policy sectors too (EEA 2003).
Each policy area has in addition to EIA/SEA a particular set of measures to integrate biodiversity. These are particular well established in the agriculture and forestry sector. But even when measures are foreseen, there is no guarantee that sufficient resources (budget) are available (see e.g. II axis of CAP 2007-2013).

Some may argue that political will (here: implementation) and budgets are two issues that can't be influenced by science and academia directly. So what is the role of science and researchers to improve the situation?

The communication mentions four key supporting measures to achieve its objectives and building partnerships is one of these. In building progressive partnerships a role for academia is foreseen (COM 216, p.14).

Science should provide the EU institutions with the necessary data to perform the evaluations and assessments of activities under objective 2.

Furthermore scientists should engage in providing guidance documents for Member States. These documents are of course elaborated in special committees, but regularly there is room for external expertise. This includes expertise from natural scientists as well as from socio-economic sciences.

Recommendation: Make sure that best available scientific data and methods for the EU level assessments and evaluations are used.

Research recommendations:

- Enhance scientific methods to evaluate the relative success of integration of biodiversity concerns in sectoral strategies / implementation plans and measures. This includes qualitative as well as quantitative methodologies.
- Develop feasible indicators to measure and evaluate the level of integration of biodiversity concerns in sectoral policies, strategies and last but not least operational plans
- Conduct research on how to enhance the effectiveness and efficiency of SEA/EIAs

Landscape Planning Tools: Designing Socially and Environmentally Resilient Systems

Dirk Wascher, Alterra, the Netherlands

Summary: The author discusses research needs on the issue of sustainable landscapes.

The classical application of landscape planning tools has been the development of spatial mitigation, compensation and adaptation schemes in response to or as part of concrete engineering and/or land use development plans (e.g. urban development, river course corrections, infrastructure, etc.) at the site and regional level. On the one hand, typical landscape planning tools are essentially assessment tools rooted in ecological concepts and focusing on GIS-based interpretations of landscape structural characteristics and visualization techniques, as well as on stakeholder participation. On the other hand, the integrative and holistic capacities of the landscape concept, providing linkages between different disciplines and an overall framework for the spatial-temporal dimension of most land-based socio-economic and environmental processes can offer practical solutions for integrating sectoral requirements (e.g. biodiversity conservation) into the much wider field of sustainable regional planning.

The EU project "European Landscape Character Assessment Initiative (www.elcai.org), for instance, was mainly concerned with European-wide approaches towards 'Landscape Character Assessment' and undertook a comparative research among 50 landscape typologies in 16 European countries. It also examined possible applications for the first pan-European Landscape Typology and Map (LANMAP2, Mucher et a. 2006) to serve as a reference base for future agri-environmental and general land use change assessments at the European level. Goal is to make the 'ontogenetic integrity' of each landscape unit spatially explicit for future impact assessments, adaptation strategies and policy development. The underlying philosophy is that indicators on both bio-physical (e.g. on biodiversity) and socio-economic information (e.g. on agricultural employment) require spatial references that are regionally meaningful and at the same tame globally responsive.

The future role of landscape planning tools within SIA can hence be summarized as follows:

- Landscape typologies as common spatial references for multi-disciplinary assessments;
- Identification of thresholds of sustainability for landscape functions at the intersection of social, environmental and economic impacts;
- The development of 'landscape-sensitive' agent-based models to better integrate regional adaptations for EU policies;
- Visualization techniques to demonstrate future scenarios of land use changes in a user-friendly format;
- Experience in stakeholder participatory procedures based on the above tools.

One of the most recent applications of LANMAP is the development of a Spatial Regional Reference Framework for the EU's integrated project on Sustainability Impact Assessment called SENSOR (www.sensor-ip.org). On the basis of landscape core parameters such as climate, soils, topography and land use, the SENSOR assessment will employ indicators for landscape functions as key criteria for judging the regional dimension of land use change impacts. In terms of

establishing thresholds for sustainability, landscape-area-based participatory processes involving regional stakeholders will provide region- and problem-specific focus on interpreting data and for developing adequate response mechanism (policies, funding, research).

The central future application for landscape planning tools goes hence beyond sectoral assessment, but aims at the design of sustainable landscapes. Sustainable landscapes will need to be resilient against impacts in order to perform a variety of functions under changing environmental (e.g. climate change) and socio-economic (e.g. WTO negotiations) driving forces. Landscapes with high adaptive capacity are able to re-configure themselves without significant declines in crucial functions in relation to primary productivity (e.g. biodiversity), hydrological cycles, social relations and economic prosperity.

In order to come to design sustainable landscapes, we have to explore the following three main research questions:

- How to arrive at indicators of sustainable development such that they can be made operational in a context of trans-disciplinary research and bottom-up dynamics?
- How to apply landscape planning tools that build upon the concepts of dynamic sustainable development, introducing the concept of resilience to both environmental and social systems?
- How to incorporate these concepts in visions of 'ontogenetic integrity' of landscapes to be understandable for all stakeholders (from local to national level)?

Re: Landscape Planning Tools: Designing Socially and Environmentally Resilient Systems

Jan Jansen, Radboud University Nijmegen, the Netherlands

In the PAN-project (http://pan.cultland.org/) we focused on several properties of cultural landscapes, including resilience. The resilience of a cultural landscape ecosystem depends on the type of management, the species and the physical environment (soil, water availability, and climate). The resilience of 'natural' ecosystems lies in their capacity to adapt to natural changes, whereas the resilience of cultural landscape ecosystems depends on the return to original or similar management practices. In general, the more culturally influenced a system is, the more vulnerable and the less resilient it is to changes in management. As a result of human impact, habitat conditions are usually substantially altered so that the system becomes more regulated by management and less by internal dynamics. Some species are filtered out because they are not adapted to the disturbance regime, others have sufficient resilience or tolerance to survive while still others invade the newly created, managed ecosystem from surrounding habitats. A cultural landscape ecosystem can therefore be considered an alternative state, brought about by human activity, to the original natural system (Jansen et al. 2007).

In addition to your very interesting contribution, I have a question. In your last remark you were speaking of designing sustainable landscapes: Do you think we can actually realize sustainable landscapes?

Of course there is at random triggering but indeed also deliberate steering involved. Mainly economic drivers, superimposed on the natural factors, are responsible for the landscapes we see today. The traditional cultural landscapes with high biodiversity were also a result of it. But these drivers were mainly operating

regionally, linked with the regional natural conditions. It was the time that Europe had a huge variety of regional products coming from regional social-economic cultures. At present we undergo wide-scale economic changes that are more and more reflected in the increasing changes in our landscapes and the people that live in them. For instance the demographic changes (see the contribution of Herbert Prins earlier in this session).

So this question is perhaps the most challenging at the moment: Would it be both technically and politically possible to come to sound sustainable landscapes that are (highly) socially and environmentally resilient to the present global changes?

Planning sustainable landscapes

Dirk Wascher, Alterra, the Netherlands

Before addressing your question on the principle possibility of engaging in the planning of sustainable landscapes at the supra-regional level, I would like to react to your thoughtful input on the question of resilience with regard to cultural vs. natural ecosystems.

You quite rightfully stress the need to differentiate between different types of resilience when distinguishing cultural and natural landscapes. Following this intention, I would characterize the situation as follows:

The resilience of natural landscapes (i.e. proportions or associations of ecosystems) such as periodically flooded grasslands, moors and peatlands, dune systems, forest communities, etc. is marked by the ability to persist against external or internal disturbances set off by newly arising processes and structures (Holling 1973, Peterson et al. 1998, Gunderson 2000). The resilience of a specific ecological organization is measured by the amount of change that a system can experience before it is forced to reorganize. Once the threshold of a system's resilience has been passed it will change its organization and appearance. These thresholds change between landscape to landscape (Wascher 2005). This state does not need to last forever. Quite contrary, it can return after some time. The latter addresses the stability of a system as its ability to return to an equilibrium state: the more rapidly it returns and the less it fluctuates, the more stable it would be. The resilience of a natural landscape, on the other hand, describes its ability to persist, to absorb change and disturbance and still be recognizably the same ecosystem (CSIRO, 2007). Both the stability and resilience of natural landscapes depend strongly how disturbances affect vital functions of their regenerative processes.

On the other hand, cultural landscapes are generally the product of an interference regime which determines and artificially schedules regenerative processes, e.g. sowing seeds, irrigating fields, grazing grasslands etc. Given the high frequency of many of these regenerative processes (some of them, like in forestry, are less often, but by natural standards still much more frequent), the relatively low level of species richness and diversity, as well as the high level of system saturation (eutrophic conditions), many cultural landscapes are in my view much less vulnerable against certain disturbances - also because the peak of these disturbance (e.g. deforestation, plowing, drainage) have had their impacts many decennia or centuries ago, in fact they contributed to establishing the cultural landscapes. The typical disturbances affecting cultural landscapes are land use abandonment and/or intensification, loss of region-specific management devices, of but also climate

change impacts (including accompanying extreme weather events) (Opdam and Wascher 2005).

To my mind, the question whether cultural landscape are resilient, is in the mid-term mainly dependent on socio-economic parameters (demographic trends, income opportunities, agricultural but also energy policies) and in the long-term on climate change adaptation strategies. The resilience of natural landscapes, on the other hand, will much more depend on ecological parameters such as habitat coherence and size, open vs. closed systems, and spatial-geographic adaptation potential - e.g. ecological networks.

This leads directly to the question whether we will be able to plan and design sustainable landscapes. I think the answer can and must be answered with 'yes'. Though this might be considered as a rather predictable point of view from the "land of planning" (The Netherlands), it does not require a Dutch perspective to come to the conclusion that land cultivation processes that produced unbalanced, "hyper"-states of landscape in which natural resilience is substantially decreased or has disappeared, and were cultural resilience depends on economically unsustainable regimes can also be reversed - if European societies would like to see this happen.

Already today, essential aspects of land use planning is tackling sustainable objectives: e.g. the restoration of riparian corridors to offer more retention space for seasonal flooding in parts of the Oder, Elbe or Rhineland. These are admittedly only addressing core interests of human settlement protection. But sharp declines in EU subsidies for agricultural production will redefine sustainable agriculture, especially in the light of Climate Change policies and adaptation measures. Modern cartographic products such as the European Landscape Typology (Mücher et al. 2006), innovative forms of agricultural land use, and more interactive ways of policy implementation involving regional stakeholders and producers alike, can make it possible to establish new and maintain old regionally specialized production centers, offering cultural landscape resilience on specially designated areas (e.g. flooding zones, poor soils, scenic parks) and natural landscape resilience in form of ecological networks throughout. The challenge will be to establish decentralized dynamic market systems where economic profit is re-invested into regional sustainable goals, monitored and if necessary co-subsidized on the basis of European indicators and priorities.

Re: Planning sustainable landscapes

Jan Jansen, Radboud University Nijmegen, the Netherlands

My question in the last post needed more precision. I forgot to explicitly add to my question "and at the same time to keep an acceptable level of biodiversity, or at least not a drop after 2010".

Dirk, you wrote that once the threshold of a system's resilience has been passed it will change its organization and appearance. My fear is that our landscapes will be stripped of their biodiversity more and more until perhaps a new alternate state is installed. Perhaps a relative steady state, balanced on economic, ecologic and social pillars, but at a (much) lower level of biodiversity. But perhaps we can get back to a higher organisation level. I really hope so! But doubts remain.

On the basis of current scientific knowledge, we still cannot predict what the outcomes and impacts will be of ongoing change on the quality of our lives and

environment. Perhaps such problems, in the words of Einstein, “cannot be solved at the same level of thinking we were at when we created them”.

The progression between the various steps that make up the typical sequence of landscape development has been greatly accelerated in recent years. The sequence typically goes through the following stages: pristine wilderness, agro-cultural landscapes and agro-industrial landscapes that are normally accompanied by large-scale urban landscapes. Beginning in the later phases of the nineteenth century and accelerating, at times almost exponentially, landscapes that previously stayed relatively stable over periods that spanned several human generations, are experiencing disturbances and changes in management of unprecedented intensity. Since the Industrial and later the Green Revolution, which resulted in increased food production through the breeding of new plant varieties and the application of modern agricultural techniques, continuity of management has been replaced by discontinuity. In many instances, the changes brought about pressures that were beyond the resilience/tolerance levels of several of the floristic and faunal elements with the result that vulnerable species that could not adapt to the radical changes were lost; similarly, what were perceived to be economically non-profitable structures and practices were removed and allowed to lapse, respectively.

Traditional landscapes were closely adapted to local conditions. Traditional farming practices responded, out of necessity, to local conditions such as climate, topography, hydrology and soil types. This sensitive use of natural resources produced a patchy landscape. Certain soils, for instance, were more suited to the high demands placed on it by arable crops while others were more suited to hay making or extensive, year-round grazing. The result was a complex and diverse landscape, even at the small scale level of local communities. Nutrient and energy cycles were locally rooted, as is well exemplified by the infield/outfield system. In contrast, modern farming relies more and more on remote inputs and the outputs are often destined for distant, global markets. The result is landscape uniformity through large-scale intensification. Whereas traditional landscapes exhibited diversity and had a strong regional character, modern landscapes have increasingly comparable structure and there tends to be a sameness in the flora and fauna as a result of the use of industrial-scale management practices that involve use of herbicides and pesticides to control unwanted species that inevitably find favourable conditions within mono-cultures. What extent these processes are really affecting our long-term essential resources is a question that must be addressed before irreparable harm is done to the European and global environments.

A further aspect to be borne in mind is that the natural conditions under which both natural and cultural landscapes developed are often no longer available and, furthermore, present availability is no guarantee for the future in that human-induced climate change on the global scale and genetic manipulation on the nano scale may result in changes that are irreversible.

However I stress that we should continue searching for possibilities to come to better feedback systems. I fully agree with you that the challenge will be to establish decentralized dynamic market systems where economic profit is re-invested into regional sustainable goals, monitored and if necessary co-subsidized on the basis of European indicators and priorities. IA few years ago I stood at the cradle of a project which I named “Lifescape- Your landscape”. This project is an example of an attempt to “explore new ways to profit from the rural landscape while preserving its beauty”. Multidisciplinary projects like these may help to come to more sustainable landscapes (www.lifescapeyourlandscape.org/users/lifescape/).

Re: Planning sustainable landscapes

Mauro Agnoletti, University of Florence, Italy

Describing cultural landscapes as the results of the product of an interference regime which determines and artificially schedules regenerative processes seems to present the role of man as a disturbance affecting natural evolution. In places where cultural landscapes have existed for 3000-4000 years, man is rather the dominant ecological factor affecting not only farming areas, but also density structure and species composition of woodlands. The creation of 60-80 land uses organized in 600 patches in an terraced mountain area of 1000 ha (Agnoletti 2006) shows that the ecological system is totally embedded into a socio-economic system which can hardly be considered as a disturbance according to a historical persistence of at least several centuries.

According to this, the resilience of a cultural landscape is also given by the different level of vulnerability. A beech forest managed for timber is likely to present a lower degree of vulnerability in respect to a chestnut grove. They are both negatively affected by abandonment but the speed of the degradation is faster in a chestnut grove, that requires no understory and a regular management of single trees, while a high stand of beech can survive with no management for a much longer period. In the same way a terraced slope with dry stone walls and mixed cultivations is very rapidly degraded by abandonment, because the lack of maintenance will allow erosion and eventually the collapse of the whole system.

In any case both chestnut orchards and terracing, once turned into mixed forest or a woodland as the result of abandonment, cannot be restored, especially if they are in protected areas, according to a concept considering mixed forests and forest land as having a higher ecological value. And also because habitat fragmentation is seen as a danger. This has affected also the restoration of pasture and wood pastures in Italy, known as having a high level of biodiversity when correctly managed, but impossible to restore (by law) if secondary successions have created a new forest.

The question of whether cultural landscape are resilient is not only dependent on socio-economic trends but also on technological development in farming and forestry, and by inappropriate policies enhanced by the European Union, generally favouring the abandonment of farmed land (especially traditional cultivation forms not suited for industrial production), and renaturalization. This poses several questions also for the implementation of the European Landscape Convention and Sustainable management criteria and indicators promoted by several institutions.

Re: Planning sustainable landscapes

Alessandro Gimona, Macaulay Institute, UK

Another way to say that European landscapes are cultural landscapes is to highlight the fact that biodiversity policy cannot be considered in isolation by decision makers, because public policy making is often a pragmatic process involving trade-offs between the potentially conflicting demands of various parties. Therefore, sustainable landscapes have to be multifunctional i.e. meet other socio-economic requirements that coincide/conflict with good ecological conservation options, such as ground water protection, recreation, aesthetic values, agricultural production, transport etc..

One important applied research need is to identify landscape areas that can deliver multiple benefits (including biodiversity) from various stakeholder points of view. At the same time, it is also necessary and probably crucial, from a political point of view, to find sound ways to incorporate stakeholder's views in the planning process.

Another related research need concerns the design of economic tools and incentives for farmers/land owners [i.e. in many countries, such as the UK, the principal agents whose decisions affect landscape sustainability]. Once 'public' goals and spatially zonations for our landscape planning have been identified, how can we encourage landowners to make decisions which are consistent with these goals? E.g. not to abandon marginal land or to de-intensify productive land etc? Economic incentives are part of the solution, but it is quite clear now that there are also many *social* factors that need to be understood to make the incentives successful in terms of biodiversity protection and other objectives.

Finally, the effect of scale on the planning process should also be considered, as this is likely to influence the results of analytical stages. Given that, ultimately, the processes maintaining biodiversity (e.g. the balance between speciation and extinction) happen at the scale of biogeographic provinces, a multiple-scale approach is required.

Countryside Quality Counts: Going Beyond the Data

Roy Haines-Young, School of Geography, University of Nottingham, UK

Summary: We need to go beyond the process of monitoring biodiversity loss and draw upon understandings of stakeholder values and visions if we are to assess the significance of environmental change and show how biodiversity targets can be aligned with wider societal values.

Rural landscapes in Europe are changing as a result of complex social, economic, and environmental drivers acting at different spatial and temporal scales. As the 2010 target illustrates, it is accepted that the rate and scale of change now threatens key ecosystem and landscape values.

Policy responses to the problem of biodiversity loss are difficult to develop, however, because of the cross-cutting nature of the processes concerned. This paper describes an integrated, assessment of the changing quality of the rural environment in England that has considered biodiversity objectives alongside other the other values associated with cultural landscapes. The study, known as Countryside Quality Counts (CQC), arose from a Government commitment to publish an indicator of change in countryside quality that took account biodiversity, heritage, and the overall character of the landscape. The case for such an indicator was that the linkage between people and their environment needed to be clearly identified and communicated if landscapes are to be managed sustainably.

The CQC Project accepted that while notions of 'countryside quality' had a number of dimensions, a key aspect was that of 'local distinctiveness'. The study drew upon the work on landscape characterisation that had been developed in the UK in the 1990s, which provided both a systematic approach to the description of landscape character and an account of the major national landscape units. It was argued that if the distinctive properties of landscape character could be described in terms of patterns and qualities of the elements such as woodland, boundaries, agricultural land cover, and settlement and semi-natural habitats, then the change in landscape character over time ought potentially to be detectable.

The CQC project used publicly available data to track landscape change for two periods, 1990-1998 and 1999-2003. The analysis then sought to answer two key questions: 'Where is change occurring?' and 'Do these changes matter?' The experience gained suggested that while the spatial analysis was relatively easy, judgements about to the scale and direction of change could only be made by going beyond the data to look at the values and visions that people held for the different landscape areas. These values and visions included those relating to biodiversity and the distribution and management of semi-natural habitats, and the importance of these elements in relation to the wider landscape and local cultural and historical heritage. A two-stage programme of consultation was undertaken with people who knew each landscape area. The process identified the types of change that might strengthen or erode landscape character, and then went on to test the judgements made about the changes observed. As a result, for the two time periods CQC identified where landscape character was being strengthened or maintained at the national scale, and where it was being eroded or neglected.

If biodiversity targets are to be met then the restoration and management of semi-natural habitats needs to be seen as part of a broader attempt to sustain landscape quality. The landscapes of England, like those found elsewhere in Europe, have to be considered from a multifunctional perspective. Biodiversity targets and objectives must take account of both biophysical constraints and the socio-cultural aspects of the landscapes in which ecosystems are embedded. In the long-term, biodiversity resources will only be restored or sustained if we ensure that future social, economic and environmental goals are closely aligned. The CQC Project illustrates how this task might be attempted.

The abandonment of agricultural practices and Traditional Ecological Knowledge

Yvonne Cerqueira

Rapidly we are witnessing an increase in the abandonment of agricultural practices. The abandonment of these practices has contributed to a decrease in biodiversity and has therefore alerted ecologists, conservationists, economists and worried citizens that something has to be done. We humans have a tendency to forget that we are constantly evolving and when we cannot adapt to the situation our natural reaction is to fight against that force. Well, life 60 years ago is exactly that life 60 years ago. During those hard times many people who lived further away from villages and towns where forced to live off the land and respect its existence, for nature's existence depended on their survival. It was a give and take relationship. Those people who once lived off the land are now in their late 70s and 80s and no longer have the strength to take care of themselves let alone the nature that surrounds them. But they do possess something valuable: their "traditional knowledge". Throughout centuries these people were able to adapt and understand nature's complexity without a university degree. To me that is amazing and something that is worth treasuring. They are able to describe plant life cycles, predict weather conditions and so much more, knowledge that has been attained through centuries of experience and which has been passed on from one generation to the next.

Traditional Ecological Knowledge or TEK is an important source of information and understanding for anyone who is interested in the natural world and the place of people in the environment. The combination of traditional knowledge and western science has been used in Canada and the United States as a form of protecting and enhancing fish and wildlife resources. These two countries believe that this combination of TEK and western science can serve as a model for ecosystem management throughout the world. The disappearance of agricultural practices primarily in the northern regions of Portugal is having a negative impact on biodiversity and it is the elderly people that hold the key or better still the answers to sustaining these areas of high natural value.

It is clear that subsidies, primarily those of agri-environmental measures and compensatory allowances, are not enough to motivate agricultural activities in these remote areas. Studies carried out by ARDAL (2002) in Portugal revealed that most of the young people that live in these remote areas work in the nearest village, employed in the industry or services sectors. To them agriculture is viewed as hard work and work that does not pay off. To be honest I don't blame them since in most cases this is true. Increasing compensatory allowances is not enough and is not the answer to the abandonment of agricultural practices. Another issue is that the majority of these elderly farmers are not willing to sell their land and so the land is passed on to their children or grandchildren who in many cases have immigrated to other countries or just aren't interested in farming the land. So what is the answer to this problem? Well I believe several measures can be taken, first and foremost elderly people need to be informed of what is happening, most of them already know what is occurring but they see things from a different perspective which is related to the way they value nature. The elderly have to be involved in the solution since they know better than anyone else the history of the land and possess viable traditional knowledge. Most importantly the younger generations have to be actively involved; the future of these biodiverse areas is in their hands. If the elderly can no longer farm the land and the

young aren't interested, conservation programmes need to be implemented. Below I have outlined what I believe to be the main research priorities in this field:

1. Information needs to be documented; this is information detailing the techniques and methods used in agriculture (management systems and land use) by the elderly for centuries (LEK –Local Ecological Knowledge). Documentation should include information on flora, vegetation, and fauna inventory and also practices involving the use of natural resources in a sustainable matter.

2. Encourage education in traditional ecological knowledge and devising more formal means for their maintenance and practice.

3. Stimulate research that will incorporate the traditional knowledge and participation of the elderly (a form of adaptive co-management between western science and TEK).

In Portugal agricultural activity was the main activity in these remote communities for a very long time and so the abandonment of agricultural practices will have a large effect on ecosystem services and biodiversity. These abandoned areas are highly susceptible to shrub and wood invasion therefore increasing the risk of fire which I think is one of the main threats to Portugal's biodiversity primarily in forested and agricultural areas. In conclusion I would just like to state that the abandonment of agricultural practices in these remote areas threatens the entire ecosystem and with the disappearance of these practices comes the extinction of viable traditional ecological knowledge possessed by our elderly who have lived all their lives side by side with nature.

Fighting illegal poisoning in the countryside

Sergio Couto and **José Eugenio Gutiérrez**, Gypaetus Foundation, Spain; and **Antonio Ruiz** and **Miguel Ángel Simón**, Junta de Andalucía, Consejería de Medio Ambiente, Spain

Poisoned bait has been used as a predator control method since ancient times. The first official record of this method in Andalusia, intended to kill wolves with strychnine bait, dates back to 1575. This indicates the strong cultural roots of this practice in rural areas, not only in Andalusia, but in Spain and in other EU countries. Currently this method is illegal in the EU, but it still causes critical damage to biodiversity, being the main cause of non-natural death for several endangered raptors and carnivore species across Europe, threatening the goal of stopping biodiversity loss by 2010.

Use of poisoned bait is mainly related to incorrect and obsolete predation management on small game hunting estates. A second and less common cause is the use of poisoned bait by stockbreeders to eradicate feral dogs around their stockyards, especially during the birth season.

Recently, several action plans have been issued in Spain to coordinate and promote actions to stop this practice. At the Spanish level the strategy, Estrategia Nacional contra el Uso Ilegal de Cebos Envenenados en el Medio Natural, was launched in 2004. In the same year a regional strategy was also issued for Andalusia: Estrategia para la erradicación del uso ilegal de cebos envenenados en Andalucía (Simon al., 2006) (an initiative from the Consejería de Medio Ambiente of the Junta de Andalucía), and in 2005 the Gypaetus Foundation Action Plan against Illegal Poisoning (Gypaetus Foundation, 2005), was launched, (soon available in English at www.gypaetus.org). At the Andalusian level, both the Andalusian Strategy and Gypaetus Foundation Action Plan have met with great success, serving as a reference at the national and European levels. Some of their most remarkable actions and initiatives are the Canine Team for inspecting estates in the search for poisoned bait, the legal withdrawal of hunting activities on around one hundred estates for up to a maximum of two years (Simón et al., 2006), Andalusian Strategy) and the Network of Municipalities Against Poisoning intended to offer free legal and technical tools for fighting poisoning in over 750 Andalusian municipalities (Couto et al., 2006).

All these initiatives spring from the fact that illegal poisoning is a major threat for the conservation of several endangered species, and this assessment is now possible thanks to the literature about the effects of poisoning on raptor populations, civil service databases obtained from specialized wildlife analysis and diagnosis centres (such as the CAD of the Consejería de Medio Ambiente de la Junta de Andalucía) and unpublished reports about illegal poisoning (Hernández 1999, 2000; Hernández et al., 2001; Couto et al., 2005). This information has influenced political, technical, legal and land use decisions, such as the implementation of the reintroduction of the Bearded Vulture in Andalusia, the use of reports in trials about the impact of poisoning on wildlife and the withdrawal of hunting activities on some estates.

Despite great advances in the fight against illegal poisoning, a significant lack of information exists in most of Europe about this problem. As an old problem only recently being confronted in some regions, literature about the impact of poisoning on wildlife is scarce, especially literature about management measures implemented to

avoid its use and about the social perception of illegal poisoning. There are few exchanges of experiences at the European level about actions to eradicate this crime, and there is a lack of standardization of systems for monitoring poisoning between regions and countries that makes it difficult to produce comparisons and further analyses.

In our opinion, there are currently two priorities in extending and improving the fight against illegal poisoning in Europe. The first priority is the research and publication of relevant information about the situation of the problem in EU countries and especially, when the data is available, any medium and long term analyses. The second is the establishment of international experience programs for sharing management measures for fighting this crime and ways to extract information from such the complex scenario that is illegal poisoning.

Genetic diversity of crop varieties, livestock breeds and races

Allan Watt, Centre for Ecology and Hydrology, Banchory, UK

One aspect of sustainable use of biodiversity that has not been discussed in this e-conference is the genetic diversity of crops and livestock.

In the UK, for example, there has been research on possible long-term change in the genetic diversity of agricultural crop species such as wheat and barley. Research outside Europe has included work on genetic diversity of pigeonpea *Cajanus cajan*, an important subsistence crop in India (Burns et al., 2001).

The conservation of livestock breeds is critical for the provision of resources for the future of agriculture, particularly in the developing world (Hall and Bradley, 1995). Recent advances in the methods used to investigate of genetic diversity in livestock breeds have, for example, been used to assess the risk of extinction of particular breeds (Gandini et al., 2004) and to use naturally-occurring genetic variation in breeding programmes (Bishop and Woolliams, 2004). Related socio-economic research includes the development of methods for economic valuation of farm animal genetic resources (Drucker et al., 2001).

Research on non-domesticated harvested species includes work on timber species such as cedars and mahoganies (Cavers et al., 2005).

Despite these and other studies, a major research priority must be to quantify trends in the genetic diversity of harvested and domesticated species and identify policies and practices that ensure its long-term sustainable use.

Genetic diversity of crops and crop wild relatives

Brian Ford-Lloyd, School of Biosciences, University of Birmingham, UK

I welcome the comments from Allan Watt regarding trends in loss of genetic diversity in plants and animals, because it is an area that does not receive as much attention as is merited by their socio-economic significance. The scientific studies that have been undertaken are few and far between, and those that Allan quotes represent nearly all of them (he misses out work by Donini et al on wheat). Little attention has been paid to the likely loss of genetic diversity resulting from the replacement of traditionally grown landraces by modern cultivars. This is a widely recognised phenomenon, concerns over which gave rise to the significant ex situ conservation in genebanks from the 1960s onward. It is therefore surprising that, notwithstanding the vast numbers of accessions now held in gene banks, only few attempts have been made to determine how much this has halted genetic erosion. Just as important are crop wild relatives which grow in natural habitats, which are relatively very underrepresented in genebanks and where genetic erosion in situ is most likely to be occurring. Its extent however, in terms of loss of alleles of potential economic importance to plant breeding, remains more or less unknown.

My involvement I recent research, yet to be published, indicates that between 1961 and 1995 there has been no identifiable loss of genetic diversity amongst rice landraces in south and south east Asia. The research also clearly indicates that numbers of distinct landraces are a good proxy indicator of genetic diversity. So, for rice in this part of the world at least, if there has been genetic erosion the rice crop

since 1995, this could relatively easily be detected simply by counting the number of landraces still being cultivated on-farm. Whether this is possible for other crops remains to be seen, and represents research that needs to be done.

Fishing trip

Dave Carrs, Centre for Ecology and Hydrology, Banchory, UK

Reading Allan Watt's recent contribution on the genetic diversity of crops and livestock made me think about fish - their diversity, communities and their sustainable use. As Chair of the INTERCAFE Cost Action (see www.intercafeproject.net), we are a network of natural and social scientists working with local people to explore issues surrounding cormorant-fisheries interactions in 29 countries across Europe. This seems to be a model system for many of the biodiversity conservation, interdisciplinary, and sustainable use issues under consideration. Several issues seem pertinent.

The cormorant - a large fish-eating bird - has increased dramatically across Europe in the last couple of decades, a great conservation success for some (like almost all European wild birds it is afforded legal protection) but an apparent disaster for others (see Carss and Marzano 2005). Having (presumably) reached a favourable conservation status, the species has many of the traits of an invasive/alien species (e.g. flexible breeding/foraging behaviour, rapid population growth, speedy geographic spread/colonisation) and it is certainly perceived as such by many people.

In association with the cormorant's increase, many of Europe's coastal and freshwater fisheries (both commercial and recreational) have declined and there are increasing attempts to conserve many species of fish. There is however little (if any) evidence to suggest this relationship is causal - many fisheries declines can be attributed to human influences, particularly to over-fishing, habitat modification and the associated changes in fish community structure (see Carss et al. in press). One of the ways people have tried to increase fish stocks (in freshwaters at least) and to make their fisheries sustainable is through the artificial stocking of hatchery-reared (sometimes 'domesticated') fish. In many, many European waterways hundreds of thousands, if not millions, of these fish are released each year. Putting it crudely, many of these hatchery-reared fish have lost their anti-predator behaviour in favour of their risk taking (i.e. feeding and growing) behaviour. Consequently, they may be especially vulnerable to predators such as cormorants.

At the same time many artificial fisheries (often with unnaturally high densities of fish) have sprung up offering instant gratification to recreational anglers - at a financial cost.

In many areas of Europe we now have a situation where “protected cormorants are foraging on protected rivers and eating protected fish”. INTERCAFE was set up to explore these complex and interrelated ecological, social, cultural, political and economic issues. Indeed, far more interdisciplinary research is needed because addressing conflicts over natural resource use requires a holistic approach. Many important issues surrounding how to do interdisciplinary research have yet to be resolved (e.g. Marzano et al. 2006). A greater awareness of both social and natural science perspectives, and how they inform each other, is clearly vital to understanding and facilitating the interface between local people, researchers and policy makers and hence to improving the sustainability of social, environmental and economic well

being. In terms of specific research priorities, we need more research examining the processes and cost-effectiveness of interdisciplinarity and 'collaboration'.

Given the (economic and recreational) importance of European fisheries, much more consideration should be given to their sustainable use. Looking through the cormorant's eye, three major natural science research priorities are clear. First, how are "conservation success" species to be best managed at the continental scale where their impacts on other species of conservation concern are apparent? Second, we just do not know enough about fish and what affects their distribution and community structure. Third, given the parlous state of our fisheries, can we identify policies and practices that may ensure (a) the conservation of fish species, (b) the restoration of more natural fish community structures, and (c) their long-term sustainable use?

Re: Fishing trip

Morad Awad, NIOF, Alexandria, Egypt

I suggest extending small scale aquaculture fishing bonds wherever there are freshwater springs and natural water pools that dissipated from underground. This issue has important socio-economic impacts on desert communities and poor people that living far away from big cities and marine life, especially in developing countries. This needs a big effort to study the most favourable fish species accustomed to such bonds, and how far the living stocks would be stored in terms of aquaculture (quantitatively and qualitatively) i.e. environmental, biological parameters and water quality interactions that dominate each water mass.

Sustainable underground water supply sources are of prime importance to start such types of communities. I think a significant part could be assigned especially for those developing countries having natural water bonds and/or of poor coastal areas.

Soil biodiversity

Allan Watt, Centre for Ecology and Hydrology, Banchory, UK

I think that there has been too much emphasis on conservation of biodiversity (important as this is) in this e-conference and not enough discussion on sustainable use of its components. Moreover, we have not put enough emphasis on those organisms that sustain agriculture and forestry such as the insects, bacteria, and fungi that David Pimentel referred to early on in the e-conference.

Perhaps the most important component of biodiversity in this regard is soil biodiversity, which is threatened by, for example, GM plants, nitrogen deposition, zinc and other metals, pesticides, oil and other contaminants, soil tillage practices, overgrazing and forest fragmentation. All components of soil biodiversity are at risk although those thought to be most at risk are species-poor macrofaunal shredders of organic matter, soil bioturbators, specialized bacteria such as nitrifiers and nitrogen fixers, and fungiforming mycorrhizas (Brussaard et al., 1997).

Research is needed to develop standardised approaches to monitoring soil biodiversity, quantify the impact of the major pressures on soil biodiversity (particularly their interacting effects) and establish ways of alleviating these pressures.

Re: Soil biodiversity

Carlo Jacomini, Italian Agency for Environmental Protection and for Technical Services, Rome, Italy

I perfectly agree with Allan Watt. Over three quarters of terrestrial biodiversity (95-98% according to some authors) is beneath our feet, and we never take it into account. I am personally sure that they (all soil organisms, or at least a great bulk of them) will manage to overcome this human invasion of their own environment, as well as they survived the last three (or maybe four) mass extinctions. Nevertheless, it is in their huge potential that we (as we are a species in high risk of extinction) should investigate and research, because this is the foundation for simple, practical and successful long term survival strategies, at all levels:

- Community (their food web can only be compared to the one of coral reef, with extraordinary exchange of roles and niche shifts in sympatry);
- Ecosystem (their role is essential in energy, matter and information turnover, and their resilience and resistance are often underestimated);
- Species (both for their diverse and radiative forms, and for their extraordinary adaptations);
- Individual (an evolution of specific and excellent series of environmental sense organs, much more efficient than our space dreams, in less than 1 mm, not to speak of their successful reproduction strategies); and so on...

In Italy, the richest country in Europe as far as soil biodiversity is concerned, thanks to a national programme based only on scientific interest, there is a group of research institutions and local administrations (Regional and Provincial Agencies for Environmental Protection) who are watching far beyond their needs and budgets, and are willing to share their knowledge and expertise, to improve and improve the soil biological monitoring and assessment methodologies proposed until now.

The path is long, of course, but a wider approach at the EU or International scale is only desirable. A first step in this direction will be the next EU Directive on Soil Protection, which is considering soil biodiversity as one of the components to take into serious consideration for all the threats and menaces to soil.

But I guess more useful hints might derive from this widest contest and melting pot. Many thanks to the organisers for their efforts and to all participants for their interesting contributions!

Session II: European biodiversity research and the global perspective

Session II Introduction: European biodiversity research and the global perspective

Gerry Lawson and Jacques Weber, Session II Chairs

Further information will be posted soon on the conclusions of the previous e-conference organised by the BiodivERsA Project (www.eurobiodiversa.org). In the meantime I would like to suggest some issues that seem to me to be research priorities. The list is partial, and incomplete: my purpose is to help start a discussion.

The overall challenge is the same all over the planet: how to maintain the evolutionary potential of living systems, and the environmental and societal services of biological diversity. In developing countries further challenges of poverty alleviation and sustainable exploitation of biodiversity are added.

So, questions for discussion might be:

1. The identification of biodiversity is still far from complete in tropical areas, but do we know enough for policy makers to prioritise conservation and sustainable use initiatives?

2. How can biodiversity be managed to preserve particular 'hotspots' and at the same time maintain the living standard of neighbouring human populations?

3. Climate Change impacts particularly on developing countries - how can research, conservation and sustainable exploitation of biodiversity predict and mitigate these changes?

4. How to ensure biodiversity conservation in the context of poverty, and individual or communal rights to land and produce?

5. Can biodiversity modelling be combined with modelling of societal and environmental pressures to predict ecosystems functions and services, and effects of policy changes?

6. What lessons are to be learned from conflicts for access and use of renewable resources, for example living resources and water?

7. What lessons are available from projects that integrate research, conservation and development agendas in the tropics?

8. What has been the impact of the CBD and MDGs in developing countries? Are there success stories of Biodiversity Action Plans - and have colleagues in the developed world contributed to these?

9. Are greater efforts needed to collect, collate, and make available research results, taxonomic databases and socio-economic surveys?

10. How effective have the European Union development and research programmes been in assisting biodiversity conservation and sustainable use in the tropics?

Re: Session II Introduction

Jorge Soberon, University of Kansas, USA

1. As almost everything in biodiversity, the question is scale-dependent. At what scale do we know enough? At the scale of entire countries, and for vertebrates and plants, we know a lot. This is true even for large Megadiverse like Brazil, Mexico, India and China. At coarse resolutions (resolutions of 10,000 km^2 and upwards), hotspots have been roughly identified. The minute, however, that you start increasing resolution at

scales that matter to local stakeholders we swim in a sea of ignorance. High beta-diversity (meaning: lots of species with small areas of distribution) dominates and the low-resolution maps of WWF or CI are simply useless but for the most general questions.

2. Scales matter, again. A CI hotspot in Mexico or in Brazil may measure 200,000 km2, or almost the size of the UK, 60% of Germany. Asking how to conserve biodiversity in areas of such size is a very major question that is impossible to answer in the abstract. How many people, what do the do? Do they own the land as private property? Communal property? Is there infrastructure? Do they have traditional, peasant economies or some degree of integration to global markets? Is there a budget? And so on. So, to be positive, in many countries there are plenty of interesting examples of success stories (sustainable forest management; biodiversity-friendly coffee; ecotourism; indigenous reserves, and so on. No single answer. No "model". Only hard lessons, one of the most important of which is, whatever the solution, it will have to include the locals, one way or another, and the locals at several scales: land-owners, regional authorities, national authorities...

3. This is an area where north-driven research, in improving the predictability and resolution of general circulation models will help a lot. After that, research on the relations between climate change and biodiversity patterns, at several scales, is important. As much as possible should be performed with collaboration of developing countries scientists. In the end, the only way out of underdevelopment is the building of national capacities. Please keep training students, helping our institutions, granting scholarships, doing research jointly with us, developing chaps.

4. Funny question, really. Ask yourselves how it happens in Europe. It happens because your institutions work, the property rights are well established, societies are well educated, aware of the issues and have the tradition of participating and the institutional ways for doing it. The cases where Europe still maintain communal rights (community forests in Germany?), probably going back to the middle ages, are well established in law. Your judges are not corrupt (beyond some probably basal levels), you have grassroots science (I mean, hundreds of scientific institutions per country), and generally speaking, governance works (it helps that you got rid of a lot of your fragile biodiversity centuries ago). And obviously, each one of your countries is more or less different in regards to all that. Those things and many others fail, in different ways and for different reasons, in most developing countries (the Like-minded Megadiverse countries include China and Ecuador. What do they have in common? Or India and Costa Rica...) . So, in my opinion, there is no single answer to the question. It is related to the degree of development according to a curve with a hump. Very very underdeveloped, probably biodiversity is OK. Middle-way towards development, generalized disaster. More developed, institutions start working, there is more budget, more education, law works better, and thus conservation improves...

5. Excellent question. We saw some hints at the global level in the MEA. Can it be done in hierarchical models that take into account the multiscale structure of both biodiversity and economy? This is truly a fascinating question. I have no clue.

6. Not really my field, but conflicts between Mexico and the USA for the waters of the Colorado and Bravo rivers show that we have to learn to generate governance over common property resources. Good question.

7. It would need a good review paper. My hunch is that the main lesson is that there is not a single lesson. Not a "model". Every success story I know (many from Mexico, some from Latin America, Africa and some in Asia) is different. In some

cases is very conservation-oriented, in others is sustainable use. In some, a lot of market tools, in others mostly traditional and community participation. Some cases in the Zapotec communities of northern Mexico are very weird mixtures of both. Perhaps a common theme is "participation": locals getting involved to the extent the "own" the project, and manage to get the technical, or whatever, know how, and empowerment, often with long-term, very committed and *respectful* help from outside. It would make a very interesting review.

8. We do not have the empirical evidence. My hunch: piles, mountains, of papers and statements of good wishes, with precious little happening in the ground. The case of Mexico I know very well. The CBD and the MDG as such, remains the province of medium level bureaucrats in the ministry of the environment. A lot is being done in Mexico (bien entendu: loads remain to be done) in relation to protected areas, management of wildlife, protection of endangered species and so on, but this is being done independently of the CBD "national Strategy". It happens because society demands it, because there are quite a few NGOs active, an increasingly capable scientific establishment, because the federal, and increasingly state governments, are becoming better at doing these things, etc. The CBD, mainly, has been a channel to GEF moneys, which in our case is substantial (about one hundred million dollars).

9. For sure. Mainly at less than global scales. Google is helping, but the cost and effort of new research increases with the square of the resolution...

10. Anecdotically, I know of several good examples of success. One case in Mexico, the GTZ work on sustainable forest in Quintana Roo state (some of the German technicians came to stay. I mean, these are not 2 years programmes). More recently, the German Luft und Raumfahrt has been training, developing capacities and locating infrastructure for remote sensing in Mexico (again, the German scientists come to live here, for many years). In Peru, Finnish scientist have helped a lot Peruvian scientists to develop their policies for their Amazonian region. I do believe there are probably hundreds of success cases, scattered and un-analysed (of course, zillions of "failures", from the developing country perspective, although perhaps papers were published and tenures obtained by the Europeans). Again, some review would be helpful. Perhaps your guys at the European Commission have some sort of inform on this.

Re: Session II Introduction

Felix Rauschmayer, Helmholtz Centre for Environmental Research UFZ, Germany

Thank you for opening the discussion on the global perspective. I'd like to reflect a bit on question 4 and to add one question, linking herewith your discussion to the session III on the MA concept:

You wrote: "4. How to ensure biodiversity conservation in the context of poverty, and individual or communal rights to land and produce?"

Reading this question, one could think that state right to land would be an ideal solution to problems of biodiversity conservation. As you know, this is far from being true. E.g. in a Byelorussian national park, the core has been enlarged not for better protecting biodiversity, but apparently for better logging trees for the state budget. Numerous other examples can be found.

Therefore, I'd like to reformulate the question: 4a. How to ensure environmentally just biodiversity conservation, and what are the possibilities for this

under different property right regimes (such as private, common, communal, state or hybrid forms)? And I'd add: 11. How to account for ecosystem services used in other parts of the world when doing sub-global MEA-like assessments?

Re: Session II Introduction

Wouter Los, University of Amsterdam, the Netherlands

My first thoughts about biodiversity research priorities and the global perspective would be much more basic, such as for example:
- Interrelations between genetic, species (population) and ecosystem biodiversity;
- Scale problems, as from micro-ecosystems to the landscape level - time effects, adaptation at different time scales.

The "session II introduction" starts from a anthropocentric perspective to identify a number of research priorities. If this restriction applies, categorizing the different suggested topics in a few research domains that are relevant to be addressed at global scale would facilitate the discussion. These domains might be:

- Knowledge about the relevant components of biodiversity (taxa, distributions, trends).
- Biodiversity functions, changes and adaptive capacity.
- (Technological, societal and political) management of biodiversity (EU and CBD programmes).
- Interactions with other policy domains (trade, food, health, combating poverty, biotech).

The role of capacity building in research cooperation

Jurgen Tack, Research Institute for Nature and Forest (INBO), Belgium

Summary: Capacity-building is a very trendy word in the international research community. However capacity-building asks a serious commitment for both the research funding organisations as well as the research organisations carrying out the research. In biodiversity research that commitment is not always present.

Capacity-building is a long-term investment in individuals, institutions, and societies to develop the knowledge, skills, and resources for meeting their own needs. Such needs could include ensuring food and energy security, resolving environmental problems, responding to human-health crises, and contributing to economic growth. Meeting those needs most effectively requires the development of scientific tools, education, and training and the application of science and technology to decisions and actions.

After performing a Google search of the internet on the search terms: environmental capacity building I found out that more than 90% of the results are referring to the role of capacity building in developing countries. Does this mean that capacity building is no longer an issue in the Western world?

In 2002 Helmut Weidner examined in American Behavioral Scientist the environmental policy development in 30 advanced and developing countries using the capacity-building approach. Findings indicated that an appropriate mix of institutions is decisive for policy performance and that formal institutionalization is helpful for longer term policy-learning processes. Globalization was found to be negative, as often claimed: rather, the globalization of environmental policies and proponents counteracts ecologically ignorant economic interests and fosters diffusion of environmental innovations. Assistance from international organizations and regimes played an increasingly critical role. Environmental and politico-administrative reforms appeared to be mutually supportive. Democratic structures and institutions were a basic precondition for effective environmental policies. Although many countries had been able to achieve environmental gains from new technologies, policies, and forms of stakeholder cooperation, even the most advanced needed to strongly increase environmental policy and management capacities to meet the continuing challenge of sustainable development.

So environmental capacity building is not only a problem of developing countries! But how is it possible that we are studying the surface of the planet Mars while we do not have a common biodiversity monitoring scheme on planet Earth (not even in the western world). How can we realise capacity building in the field of biodiversity research, including biodiversity monitoring?

Crisp et al. (2000) see 4 different approaches to capacity building:

- Top-down organizational
  - Policy development
  - Resource allocation (leverage)
  - Organizational implementation
  - Sanctions/incentives for compliance
- Bottom-up organizational
  - Workforce/professional development program

    - Staff skills, understanding, participation and commitment
    - Ideas generated and implemented
- Partnerships
    - Community activation
    - Collaborations and information sharing between organizations
    - Network density
    - Reorienting of services and programs provided by individual organizations
- Community organizing
    - Involvement of key community leaders
    - Involvement of persons from disadvantaged groups
    - Community ownership

Quite often capacity building in biodiversity research (e.g. within ERA-Net projects, Networks of Excellence and Integrated Projects) is not a specific target because of the financial impact it has on the overall budget. If capacity building is mentioned it rarely is a separate objective. It is often seen as the possible result of a multitude of smaller research contributions to a larger goal. If we really want to build up a long term initiatives in biodiversity research (e.g. LifeWatch) we have to be more serious about capacity building. Firstly, capacity building should be specified as a target. A clear definition of capacity building should be given as well as what is expected from it. Funding agreements should also describe the process towards capacity building (which of the above described approaches will be used?). The involvement of the funding body will have to be above and beyond the provision of funds. These specified outcomes should guide the basis of outcome measures adopted. Especially in the case of biodiversity research funded by the European Commission too much research results are lost and not used within the European environmental research policy.

Finally, there must be commitment to ensuring that projects initially funded with a target of capacity building are not subsequently treated as pilot projects and refunded on a recurrent basis. Such action will do nothing to convince future grant recipients that the funding body really means what it says in respect of being committed to capacity building. And is that not exactly what is happening when setting up LifeWatch as a follow-up project of the present Networks of Excellence working in the field of biodiversity research?

In the case of capacity building in biodiversity research it is not only the research topic which is strategically important but the approach of as well funding agencies as research organisations. But it is clear to all that capacity building in the field of biodiversity monitoring is more urgent than ever.

Research priorities for coastal and marine areas

Magdalena Muir, International Energy Environmental and Legal Services Ltd, UK

I am assembling a framework for climate change and coastal and marine issues for the ENCORA coastal wiki project (www.encora.org), and will be placing summaries and editing under this framework during March 2007, and for the remainder of the year.

I have adapted this framework for the e-conference, and would like to circulate it as a description of overall climate impacts and as potential list of issues and research priorities for coastal and marine areas and biodiversity. I can provide further comments during the conference.

While the document is a larger summary of the range of climate impacts and issues for coasts and marine area, the first portion of the documents summarizes some relevant reports, as well as my perception of some of the gaps of scientific knowledge that need to be addressed. All these gaps have biodiversity and conservation implications.

Gaps in scientific knowledge include:

i. Acidification
ii. Carbon sequestration and emissions
iii. Anoxic waters
iv. Biodiversity and conservation
v. Ecosystem and species shifts and extinctions
vi. Regional and local modelling
vii. Multifunction and valuation
viii. Mitigative and adaptive measures
ix. Application of precautionary approach

Sea bottom scanning for hydrated gas with relation to benthos

Morad Awad, NIOF, Alexandria, Egypt

Now, it is well documented that hydrated natural gas is dissipated near sea bottom in many locations in the Eastern Mediterranean and Black Seas. So many exploration activities are now ongoing for such investments. The relationship between such dissipation patches and the existing benthos must be studied and clarified for (sorting, classification, identification, taxonomy, migration…). In my opinion it is an important part of sea bottom biodiversity/ecology interrelationship.

The suggested topic is expected to include and attain, and not limited to:

1. Sea bottom morphology and gas venting in Eastern Mediterranean and Black sea mud volcano areas: imagery of multi-beam data and ultra high resolution seismic data for recognition and differentiation of bottom features and its bio-cover.
2. Deep sea pockmark environments in the gas saturated sediments and their effects on benthos diversity.
3. Evidence for recent and ancient fluid flow in the sea floor crust to get better understanding of submarine sediments as habitats for benthos.
4. Mud volcano discharge estimation (using temperature data) in favor of prediction and forecasting benthos divergence.
5. Numerical modeling of benthos distribution and mud volcano discharge flows using constraints.

Monitoring of biotic resources

Julia Jones, School of the Environment and Natural Resources, University of Wales, Bangor, UK

Summary: Monitoring is essential to help us make progress towards conservation goals and prioritise actions BUT it is costly and not all monitoring delivers what we need.

Nearly 200 countries worldwide have committed themselves to the target of achieving a significant reduction of the current rate of biodiversity loss by 2010 (UNEP, 2002). The EU goes even further, requiring that biodiversity decline should be halted by 2010 (EC, 2001). However we cannot make progress towards conservation goals, or prioritise actions, if we do not know the status of our targets. This makes monitoring an important issue in European biodiversity research.

We currently have limited information available on global trends in species and populations (Balmford et al, 2003, Balmford et al., 2005), although progress is being made for certain taxa at the national and even pan-European level (de Heer et al., 2005; Gregory et al., 2005; Loh et al., 2005). Pereira and Cooper (2006) recently proposed a global biodiversity monitoring network looking towards the 2010 targets and beyond. However, monitoring is costly (Sheil, 2001) and decision makers and biologists need to ensure that conservation monitoring is cost-effective.

Powerful monitoring

Inadequate monitoring can be misleading and dangerous due its inability to detect ecologically significant changes and in that it creates the illusion that something has been done. To ensure that a monitoring programme will not be a waste of resources, it must have the necessary power to detect changes of a relevant magnitude (Peterman, 1990; Legg and Nagy, 2006). One important decision, which has a strong influence on the ability of a study to detect a decline, is the level at which alpha is set. Alpha is the probability of wrongly rejecting a null hypothesis i.e. deciding there is no decline in a species' abundance when there is. Across disciplines, alpha is usually set the arbitrary value of 0.05, meaning that we have a low (5%) chance of finding non-existent trends. However in conservation, failing to detect a trend may result in irreversible changes (e.g. the extinction of a species) whereas mistakenly concluding that there is a trend when there is not may result in relatively short-term costs (e.g. over-spending on unnecessary conservation interventions). Therefore it has been argued that the statistical burden of proof should be adjusted to ensure that real instances of environmental damage are not overlooked (Di Stefano, 2001; Di Stefano, 2003; Field et al., 2004; Dayton, 1998).

Where statistically significant monitoring isn't the answer

In some cases (particularly with very rare species, e.g. Taylor and Gerrodette, 1993) it may be too costly to carry out monitoring with sufficient power to detect declines. Field et al. (2004) showed that where the cost of making a wrong conclusion about trends in a threatened species are extremely high, it may be better to go ahead and implement conservation interventions rather than to invest in monitoring. This will depend on the relative costs of the monitoring and potential management interventions as well as the value of avoiding a reduction in the target species or habitat. The type of monitoring which is appropriate will also depend on how the data

will be used. Where rural communities are the de facto managers of an area, as in many parts of the developing world, traditional monitoring may be less appropriate than participatory approaches which inform and motivate management interventions locally (Danielsen et al., 2005; Danielsen, 2003).

The future of monitoring?

Advances in remote sensing technology provide an increasingly fine resolution view of landscapes, sometimes allowing the identification of individual trees (Turner et al. 2003; Asner et al., 2005). However it is still difficult to get information on the extent and intensity of non-structural habitat disturbances (Peres, 2006). Conservation monitoring needs to occur at all scales; from fine-scale monitoring of a locally rare species, to global analyses of land-use change. We mustn't fall into the trap, however, of believing that any monitoring is inherently useful (Yoccoz, 2001). Limited conservation resources should be invested in targeted monitoring that allows us to judge the success of our past actions and to plan for the future.

Re: Monitoring of biotic resources

Allan Watt, Centre for Ecology and Hydrology, Banchory, UK

Julia Jones provides some important warnings about monitoring and indicators, as do others (e.g. Watt 1998; Sharman, this e-conference).

In relation to "powerful monitoring", Julia Jones highlights the issue of statistical detection of change. Inherent in this argument is the need to detect long-term change. Perhaps this needs to be made more explicit because of the enormous amount of natural variation in abundance of species and in the composition of communities.

A high priority for research is therefore to understand the natural dynamics of species and ecosystems in order to be able to detect long-term anthropogenic change in biodiversity. Of course we cannot afford to study all species and ecosystems no more than we can afford to monitor them all but intensive research on selected species and ecosystems will provide the basis for more informative monitoring and more effective interventions.

Re: Monitoring of biotic resources

Vladimir Vershinin, Institute of Plant and Animal Ecology of the Russian Academy of Sciences

From the outset I want to voice my point of view on the topic of modern biodiversity and biodiversity conservation. At no time has biodiversity been absolutely unchanging. It's quite obvious that the biodiversity we have now in Europe and everywhere is not "virgin". It is strongly transformed and there is no way of going back (unfortunately), unless maybe if disappeared from the planet. But anyway - let's try to stop biodiversity loss!

The problems connected with the inadequacy of some methods and results can be reduced by complexity of monitoring - usage of different systematic groups of organisms in our evaluations and long term monitoring of parameters on different levels of organisation - cytologic, organisms, populations, communities. Comparative

analysis of the same parameters in enough taxonomic distant species can also protect us from misconception and show main or specific trends in biodiversity dynamics. So we need to make observations not only of rare species, but also species that determine (or strongly affect) community dynamics.

I also want to point out one other problem of monitoring: adaptive changes in populations under the effects of environmental transformation. Due to "sinurbization" (Andrzejewski et al., 1978; Gliwich, 1980; Fedorov, 1979) - adaptation to urban conditions - populations can became less sensitive to pollution or other anthropogenic impacts. That's why we need to use complexity and long term observations in ecological monitoring practice. It's impossible to find an "absolute" method for monitoring, but a combination of those we have is a good start. It is also impossible to control and protect some species without knowledge on its biological specificity. Our experience (Vershinin et al, 2006) showed that the way mentioned above (complex and multilevel approach) is not so expensive.

Re: Monitoring of biotic resources

Klaus Henle, Helmholtz Centre for Environmental Research UFZ, Leipzig, Germany

The need for monitoring, or more precisely, the need for better monitoring and integration of existing monitoring schemes have been called for by several contributions of this e-conference and also was acknowledged by the recent meeting of the environmental ministers (Potsdam Initiative).

There is a huge amount of monitoring going on. The EuMon (www.eumon.ckff.si) project has collected information over 500 monitoring schemes even though for many European countries information is still inadequate. EuMon also develops criteria for assessing the strength and weaknesses of monitoring schemes and for setting (national) priorities. The EuMon results are in line with most arguments of Jan Jansen. However, we should not ignore that monitoring schemes have been set up for a huge range of different reasons, have their own goals, and forms of organisation. So monitoring schemes that may be entirely inappropriate for assessing European trends in biodiversity nevertheless may have their value for the goals they have been set-up for.

In my opinion what is mainly lacking, and the EuMon database clearly shows it is that coordinated monitoring schemes exist only for few taxa and there is almost no (at least no direct) funding of monitoring schemes from European sources. So we are left with a large number of research projects that contribute scientific advances to monitoring, that may produce highly valuable datasets but the achievements die away after their termination. A first step would be that the EU decides about a system on how the information and the databases generated through research projects could be maintained in the longer run and be updated at least from time to time.

Life Watch may be an option if it comes to life but we need to think also along other lines, such as European institutions that take up the responsibility to maintain and update at least core databases for monitoring biodiversity. While this is not a research issue, it is an issue of science policy interface - and once the commitment has been made, then IT-technological and methodological research is asked for again.

The unification problem again regarding monitoring

Vladimir Vershinin, Institute of Plant and Animal Ecology of the Russian Academy of Sciences

I absolutely agree with Dr. Klaus Henle that there are lot of monitoring schemes in European countries. So we need (as I have already mentioned) to create a uniform scheme for evaluation, control and uninterrupted monitoring for all EU countries that will be superimposed on national schemes (but not excluding them).

The application of this issue (maybe) lies in the creation of a constant EU centre of ecological monitoring that will concentrate all the data (collected by the unifying scheme) on biodiversity in one database that will be available for all partners. The centre will process that information using unified methods. If all technical support for this processing is in this centre it will make the data comparable and can help to decrease the amount of money spent on monitoring.

Re: Monitoring of biotic resources

Jan Jansen, Radboud University Nijmegen, the Netherlands

In my opinion we need a common understanding about what need to be monitored in order to have a good impression of the trends in species and habitats. Year after year I see discussions on monitoring, endlessly. But in talking, species cannot live!!

So I ask for a decision from the EU as soon as possible to come to a common agreement on monitoring. Now various monitoring methods are being used and I fully agree with Julia Jones that inadequate monitoring can be misleading and dangerous due its inability to detect ecologically significant changes and in that it creates the illusion that something has been done. Now very often results cannot be compared and the tax payer gets no value for his money. Sometimes large amounts of money are being wasted with inadequate methods, perhaps for political reasons or insufficient knowledge? Who knows? Anyhow, the tax payer has the right to get valid information on the state of the art.

Here the EU commission has to take the lead, assisted by a group of highly and widely respected scientists to come to a reliable monitoring system in Europe. Perhaps we have to divide several sections according to the geographical scope. If we have a reliable system we can easily compare the monitoring results of the various countries, regions, biogeographical units, etc and see the trends.

The data should be available to everybody, not only the institutions but every citizen that has interest and that even may contribute voluntarily!

Re: Monitoring of biotic resources

Allan Watt, Centre for Ecology and Hydrology, Banchory, UK

Jan Jansen argues that the European Commission should take the lead in developing a common agreement on the monitoring of biodiversity (and Martin Sharman raised the issue of common data standards early in this e-conference). It has to be pointed out

that the European Commission, notably through the European Environment Agency and the European Topic Centre on Biological Diversity, is working hard in this area.

However, the research community must have a responsibility too. It would greatly accelerate the process if researchers would agree protocols for the monitoring of biodiversity. Much progress has been done in but there needs to be agreement about protocols, not an ever-increasing list of alternatives. It is notable that the Water Framework Directive has led to progress on standard protocols and the forthcoming Soils Directive appears to be having the same effect. Nevertheless, it remains a high priority to develop agreed common protocols for the monitoring of biodiversity (and its sustainable use).

Re: Monitoring of biotic resources

Klaus Henle, Helmholtz Centre for Environmental Research UFZ, Leipzig, Germany

I agree with Allan regarding both the effort done and that a high priority remains to develop agreed common protocols for the monitoring of biodiversity.

One difference to the other field mentioned (water/soil) is that far more different organisations and monitoring schemes exist than for the other topics and that they have more different goals making the task more complicated and difficult to achieve. Steps towards it as in Bioassess, EuMon, and Alter-Net can be a starting point. LTER-sites could provide a backbone if we manage to merge their strengths with other important monitoring schemes that exist for biodiversity, some of which have a much longer tradition and a broader or different coverage.

So if we manage to develop common standards for a limited set of key monitoring schemes that allow pursuing different goals we may be able to entice others to follow. If we focus only on our own preferred monitoring schemes regarding it as superior - even if it is the best - we will never be able to succeed.

Monitoring, citizen science and biodiversity in Europe and beyond

Ian Burfield, BirdLife International, UK

When Jan Jansen argued that the European Commission should take the lead in developing and coordinating a reliable biodiversity monitoring system in Europe, Allan Watt pointed out that the EC is working towards this goal, notably through the European Environment Agency and the European Topic Centre on Biological Diversity. This is true, but in my opinion we are still a long way from the "Shared Environmental Information System" (SEIS) that is foreseen.

Researchers love the idea of developing agreed, top-down, common monitoring protocols - not just for biodiversity, but for anything they want to measure. In an ideal world, starting from scratch, this would of course be the right way to proceed. But in arguing for this in Europe, where we already have a growing wealth of information going back many decades, this risks consigning much of these hard-won data to the scrap heap - merely because they've been collected in slightly different ways in different countries. Moreover, as Jan pointed out, indulging in endless discussions on how to standardise and harmonise monitoring, while much of

biodiversity plummets towards extinction, is akin to Nero fiddling while Rome burned.

I'll illustrate my point with the example of the Pan European Common Bird Monitoring Scheme (PECBMS; www.ebcc.info). For more than a decade, the European Bird Census Council had a vision to combine the results of the national common bird monitoring schemes from across Europe to produce multi-country, multi-species indices that could be used to create policy-relevant biodiversity indicators. But, despite repeated attempts to get funding for this work (from the EU Framework Programme and other European research funding sources), they failed. In the end, it was a modest but vital injection of cash from the RSPB (BirdLife Partner in the UK) that allowed a workshop to be organised and a coordinator to be hired. The result was the Farmland Bird Index, which has subsequently been adopted by so many high-level political processes in Europe that it's hard to believe it's only existed since 2003 (it's an EU Structural Indicator, a Sustainable Development Indicator, a baseline indicator for the new Rural Development Implementing Regulation, etc.). Since 2005, PECBMS has been supported by a direct EU grant (co-financed by the RSPB) - but this would probably never have happened if a far-sighted NGO hadn't put up the starter money.

Perhaps the most interesting thing about PECBMS is that it successfully unites data collected using a wide variety of monitoring techniques from across Europe. At no stage has there ever been any top-down edict that all countries supplying their data must collect them in a particular way. The only requirement is that the data should be derived from large-scale, generic population monitoring schemes (such as the UK Common Bird Census mentioned by Alan Feest). Consequently, the national schemes that feed into PECBMS comprise a wide range of both field techniques and methods of selecting sample plots, from free choice point counts to stratified random line transects. As long as these schemes have been well-designed and are robust enough to produce reliable estimates of national species trends, then their results can be combined with others (using the software TRIM, developed by Statistics Netherlands) to produce EU-level trends, and/or with other species to produce e.g. the Farmland Bird Index.

The success of PECBMS at EU-level has led to the approval of the first so-called 'Strategic Project' of the Global Environmental Facility (GEF), co-financed (again) by the RSPB. The SEED project (Supporting Eastern Europeans to Develop Bird Indicators) is now helping national conservation NGOs from Belarus, Macedonia, Lithuania, Poland, Romania, Turkey and Bulgaria to strengthen their capacity to run successful national common bird monitoring schemes. As in western and central Europe, these schemes will be citizen science initiatives, using data collected by volunteers. Ultimately, the results produced will not only allow national indices of sustainability to be produced, but will also feed into PECBMS to make the schemes and indicators even more Pan-European. None of this has been hampered by a lack of 'research'.

This leads me into the important discussion about whether techniques to monitor butterflies, birds or any other taxa in Europe and North America can be applied meaningfully in the rest of the world (especially in the tropics). As Jorge Soberon has pointed out, the problem is not simply one of high species diversity and natural fluctuation, but also of insufficient human capacity. Some of these issues will be explored by the 2010 Biodiversity Indicators Partnership (BIP; www.twentyten.net), another new GEF-funded initiative that brings together the numerous organisations and agencies working on 2010 biodiversity indicators. It is

expected that BIP outputs will identify trends in the global loss of biodiversity, possibly by establishing 'international census plots' in representative locations throughout the tropics.

Here, then, is an area to which research could certainly contribute - by helping to develop the most suitable, sustainable, statistically powerful, change-sensitive, cost-effective methods for monitoring biodiversity in areas of the world where we have little idea what is happening, and by helping to identify representative sites. But it should also be remembered that such research is a means to an end, and not an end in itself.

Baselines

Alan Feest, Bristol University, UK

Allan Watt and Jan Jansen have pointed to the need to need to achieve some common understanding of the process of measuring biodiversity. It is therefore useful to see what validated research exists for measuring biodiversity and there are two clearly validated biodiversity measurement methodologies in existence which work to a common theoretical base:

1. Butterfly biodiversity as measured by the Pollard and Yates (1993) walk method and
2. The BTO Common Bird Census methodology (Marchant, 1994).

The basic requirements of these methodologies can be adapted to many other taxonomic groups (see Feest, 2006) and we now have good examples for a range of European taxa. These methods allow the creation of far more data than other methods due to the a) structured and defined sampling and b) counting individuals of species.

These methods allow the establishment of a variety of baseline indices for future reference and comparison of sites with statistical support for the strength of the differences/similarities. Obviously with so far using data mostly generated in Northern Europe the problem of high species diversity and how to include species which are new to science along with the high taxonomic skills needed for more species rich habitats has not been encountered.

What I would like to see is the use of these methods for high biodiversity habitats so that we can measure biodiversity change in a way that is species independent as well as the more usual species list approach (which is species dependent).

Re: Baselines

Jan Jansen, Radboud University Nijmegen, the Netherlands

Almost five years ago we had a short conversation during another EPBRS meeting. See: www.gencat.net/mediamb/bioplatform/bd_22.htm. I was wondering then and I am still wondering now if the so-called provincial monitoring-routes of Noord-Brabant, initially developed by Everts and De Vries (1994) for butterfly monitoring would be a reliable way of monitoring vegetation, or biotopes (habitats).

Now I see that you also studied the walk methods. Concluding from your contribution I notice that they are applied on moving organisms and that they are

validated for various taxonomic groups. Plant species and plant communities, the latter is the basis of biotopes (habitats if you like), are not moving, or at least very slowly (over the years). Do you think that the walk method could reliably be applied to vegetation (development)? If we do not know if this is the case then we have identified another urgent research topic, at least for those organisations that use such a method for measuring the quality of vegetation and where political decisions are based upon.

However it appears to me that the Braun-Blanquet sampling method would be the best baseline method that can be related to the best classification system of plant communities. Note that the Habitat Directive uses a classification that is based on the concept of plant communities.

Re: Baselines

Alan Feest, Bristol University, UK

I have always taken the views:

a) That we have very good validated methods for describing the biodiversity (phytosociology) of vegetation although for an animals point of view the nature of vegetation structure might be more important than the phytosociology and this structure we do not measure

b) That most of biodiversity is invertebrate and that they are influenced by vegetation structure rather than species (just let the grass grow on a grazed field and see the spider population multiply dramatically) and

c) That invertebrates (particularly rare ones) are more sensitive to environmental change than plants.

This combination of factors has led me to study invertebrates and other organisms that respond more sensitively than higher plants to environmental change (butterflies, beetles, bryophytes, macrofungi). I have devised methodologies for sampling all of these such that the requirements of the random walk (e.g straight line in random habitat and random line in ordered habitat) can be fulfilled. And it works (papers being submitted for publication but reference Feest (2006) shows how it works). I can measure biodiversity quality and show change statistically. As I said in my first contribution it now needs to be tested on more species rich habitats than northern Europe.

Re: Baselines in tropical regions

Jorge Soberon, University of Kansas, USA

The methods that Alan Feest describe are probably unsuitable for truly high-diversity habitats. The UK has a total of about 60 species of butterflies. Pakitza, in Peru, has a list of about 1,300 species. Napo, in Ecuador, more than 1,000. The piedmont of the Andes localities normally run well into the many hundreds and thousands of butterfly species.

It is very well documented that for tropical faunas, the species composition and their numbers change from year to year, sometimes by orders of magnitude. Many species are difficult to identify, being inconspicuous, drab, or very similar to

others (skippers, Lycenidae,...), or simply undescribed. Numbers of the common species can be huge. Go to a river bank during the right time of the year in the tropics and you would be overwhelmed by the sheer numbers of individuals. Rare species, on the other hand, may be truly rare, requiring sustained sampling over many months to be detected. Faunas are stratified, some species fly only in the canopy, others only at dawn or dusk, others cannot be caught without using traps... Therefore, any method that relies on the identification and tallying of individuals (as required for Shannon, Simpson etc. the way it is described by Feest, 2006) is bound to be impossible to implement, in practice, for most tropical insects. I mean, you can go and do it once. But monitoring means repeated measures. Individual-based methods based on human identification are too impractical.

Leaving aside remote sensing, monitoring of biodiversity in the tropics would have to be based on some high-tech method, like sound recognition, for birds, certain bats, certain frogs and certain insects. Another promising method is to use taxa that the normal citizen can observe (birds, mammal tracks) and develop statistical methods capable of dealing with such non-standard sampling. Individual tree-species recognition will probably be feasible soon thanks to hyperspectral, high-resolution remote sensing. Otherwise, I do not see how we will be able to monitor megadiverse high-beta and low-knowledge faunas.

Reply to Jorge Soberon

Alan Feest, Bristol University, UK

Yes Jorge there are difficulties in sampling biodiversity in hyperbiodiverse habitats and this is why I have taken the route I have to measure biodiversity quality. If one uses the concept of measuring quality, rather than recording every species present (or at least trying to) as is assumed from the CBD definition of biodiversity, then using taxonomic groups as indicators of the unsampled biodiversity becomes a reality. A recent paper by Rohr et al. (2007) in Conservation Biology does just this and shows that invertebrate biodiversity can be indicated by measuring the biodiversity of just two taxonomic groups. Incidentally I have found indices such as Shannon-Wiener and Simpson the least informative of the indices I use.

A more serious problem is how to sample the "whole" habitat and you indicate the problems. We have similar problems about the biodiversity in the tree tops and also very numerous species and one has to accept that one is sampling what one can and that it indicates what has not been sampled. This relates to your other point about how does one measure the biodiversity of organisms when much of what is being recorded is either unknown/undescribed or the expertise to identify it is not available. Most of the indices that I use do not require this certainty of identity to measure the quality of the biodiversity and the lack of expert taxonomic skills is not the disadvantage it might seem. As for difficulty of field identification we too have butterflies that are difficulty to identify on the wing e.g. Common Blue and Adonis Blue and for birds singing Blackcaps and Garden Warblers yet I have been with people who confidently identify them from their "jizz" and I have no reason to doubt them.

What I find more taxing is to understand what constitutes a sampling area; or what area should be sampled given the scales of variation. In Europe where every habitat (or nearly every habitat) is affected by human management actions or

inactions it is easy to define a sample area as either the area subject to a common management activity or which has a phytosociological unity. An example might be a disused railway line which has a varied phytosociology but a common management and could be sampled as a unit by walking along it. How would this translate to the tropical areas?

So the question still remains can the high latitude methods be transmitted to use in the lower more speciose latitudes. It would make an excellent research project but who would fund it as it is truly international in scope and impact and the organisations are not there to do this sort of thing? Or are they?

These points also relate to the points made by Vladimir Vershinin, Jan Jansen and Klaus Henle and the identified overwhelming need to have some unity in the measurement of biodiversity such that it can be compared temporally, regionally and across continents. These issues have been raised in previous "conferences" and will continue to be identified until they are solved. They will not go away as they are crucial to the whole 2010 process and the CBD and rational scientist will see clearly that to ignore them is to weaken understanding and action.

Reply to Jorge Soberon and Alan Feest

Paulo Borges, University of the Azores, Portugal

The question of "How to sample biodiversity" is an unresolved issue, mainly when we think of Hyperdiverse groups like arthropods. Based on my experience on the Azorean islands, where arthropods are not particularly rich in species, I have the following points to raise:

a) It is easy to develop a hierarchical sampling protocol (nested sampling design) and identify the several species richness components (i.e. alpha, beta and gamma diversity). The observed partition of diversity could be compared with expected values by randomization of null models using the partition program developed by Crist et al. This way we may identify the adequate scale where beta diversity is higher and invest our sampling effort in the proper scale.

b) Moreover, the relationship between the scale (grain) of the heterogeneity in species composition and the scale of sampling plots (focus) is often ignored. In fact, the implications of the scale-dependence of species accumulation processes are central to the studies relating richness and area.

c) There is still little understanding in the field of conservation biology of how historical recent land use changes in island ecosystems shapes the distribution of individual insect species. Based in a standardized sampling program we could know which species are pseudo-rare vagrant species in each target land-use type. Three dimensions of rarity could be measured: range size, abundance and habitat specialization. Three domains of rarity could be identified: "within habitat", "between habitat" and "geographic". The high dispersal abilities of many insect species together with the fact that many island species tend to be generalists imply that many species tend to be vagrants in several land use types and consequently are locally pseudo-rarities. Some species are rare in a land use type whilst more common on another often related land use, or relatively rare in many land use types. This implies a "mass effect" with many species having a "source-sink" dynamic. "Truly regionally rare species are those that are habitat specialists and many of them are threatened endemic species". Without adequate spatial data on abundances, ranges and habitat

requirements, rarity status cannot be assessed appropriately for insects on islands and elsewhere.

Therefore, even considering the difficulties described by Jorge Soberon, the only solution is to invest in adequate standardized spatial sampling!

Sampling in highly diverse habitats

Jorge Soberon, University of Kansas, USA

I see the points by Paulo Borges and Alan Feest, and I know that it is feasible to do a proper sampling, despite many problems. However, the issue is one of practicality. Assume that one of the European models is assumed, with detailed walks and stratified sampling and identification of species. How many monitoring sites do we need in order to have a decent view of what is going on? Take Mexico, with 2,000,000 km2 and a very high beta diversity (i.e., very high spatial variance on species composition). Let us be very modest and assume one station per 1,000 km2 (100,000 hectares). This means 2,000 stations. Since at the very least one sampling per year is needed the budgetary implications are serious, without going into the details of whether there are enough trained persons to do this properly, for a long period of time. Therefore I am doubtful about the practicality of doing highly detailed biodiversity monitoring the way you guys do it in low-diversity, highly educated countries. I still believe that the solution will be some combination of high-tech network of sensors together with citizen-based recording of the conspicuous groups, like birds.

Vegetation monitoring: methodological issues

Frédéric Archaux, Laurent Bergès and **Richard Chevalier**, CEMAGREF, Nogent-sur-Vernisson, France

The studies that assess the quality of plant censuses were all done on fixed-area quadrats (e.g. Klimeš et al. 2001, Scott and Hallam 2002, Archaux et al 2006, 2007); these studies found that 10 to 30% of plant species were on average missed by the botanists and a few percent of the records corresponded to misidentifications. Furthermore, the recording time, which is most often neglected in plant surveys, may be a serious cause of bias.

Unpublished data from the French ICP level II plots RENECOFOR showed the same level of overlooking and misidentification rates, so that these values are probably generally valid. These data also revealed that familiarity with the local flora, fatigue, number of censuses already done before during the vegetation season influence the census quality.

In the case of random walks, a supplementary source of error may arise from the fact that the walk may not be exactly the same from one visit to the next. Non-exhaustiveness may increase the risk of type I statistical error (i.e. finding a significant change whereas there is no change in reality).

The RENECOFOR program involves 5-year censuses on ca delimited 100 forest 100-m² plots (2m by 50m, apparently similar to the monitoring-routes of Noord-Brabant), surveyed by 10-11 experienced botanists (two visits per sampling

year). To deal with the observer effect issue, a quality assurance/control has been initiated: this program involves (1) calibration meetings during which all teams agree on the protocol, calibrate (e.g. to estimate the %cover in different vertical strata) and make some independent censuses on the same plots, and (2) reciprocal control visits, i.e. a second team visit a plot shortly after the plot has been sampled by the "usual" team. A kind of similar procedure is probably necessary in every vegetation monitoring.

Vegetation has been monitored annually in 12 of the RENECOFOR plots during a decade or so (Oxalis project, Dupouey et al 2002). This project showed that the botanists progressively add new species that were probably overlooked during the former visits; 3 to 5 years of annual sampling may be necessary to get a stabilised list of the species (although probably still non exhaustive). Thus, an initial increase in richness during the first few years of any monitoring program should be interpreted very carefully.

This to say, that monitoring the temporal change in plant richness is a difficult task; optimisation, standardisation and calibration are certainly needed. Indices "averaged" over the community (e.g. Ellenberg; mean seed longevity, etc) may (1) be less prone to spurious biases and (2) help revealing some mechanisms (together with experiments).

Re: Vegetation monitoring: methodological issues

Jan Jansen, Radboud University Nijmegen, the Netherlands

Misidentifications and recording time are indeed a serious cause of bias. Good field workers hardly misidentify species. Misidentifying often occurs when botanists enter areas they have never or hardly experienced before. As a Dutchman I studied vegetation in Central-France and Central-Portugal for several years. But the first year I walked around a lot and collected a lot of "difficult" species. Only if you really know the flora of an area can you start working. So this is a recommendation not to start counting at once but first get acquainted with the area. In contrast to making relevés, observations during walk monitoring are not exhaustive since a limited time is only permitted to make the observations.

In case of walk monitoring, as far as I have experienced it, there is indeed the problem that the route is not exactly the same as the year(s) before. But this problem is also encountered in permanent quadrat sampling, albeit less severe when the corners are well fixed. To overcome bias in recording period walk routes fall more or less in the same period (phenology).

The 50 x 2 plots that you mention are almost the same size as the 50 m sections that are used by the province Noord-Brabant. However the sections used by the province are frequently not homogenous and when the walks are not exactly the same as before the chance is real that another vegetation type is crossed. In addition not all plant species are selected for census. During the day many sections with many species are crossed which gives additional bias caused by fatigue.

As a means of assessing trends in vegetation, multiple sampling on the bases of permanent quadrats (laid in homogenous vegetation) seems to have less risks of bias. This corresponds to your remark that focusing on indices averaged over the community may be more sensible than the number of species.

The province also experienced the phenomenon that after a few years the list of plant species related to a walk route was more or less completed, showing that species were missed in the year before. However the list of route species does not equal the list of the area in which the route was laid.

I fully agree with you that research is needed in optimization, such as technical aids for field workers. The use of palmtop computers for data entry, GIS technology, remote sensing and yes standardized data management programmes that are mutually compatible. Too often data cannot be compared which is very ineffective. In addition, procedures should be simple and effective. We need reliable and practical protocols as soon as possible.

Alan Watt is right when he says that the research community must have a responsibility too and that it would accelerate the process if researchers would agree on protocols for the monitoring of biodiversity. On the other hand authorities have the responsibility to minimize bias and not to use methods that are not scientifically tested.

European biodiversity research and the global perspective: Some thoughts

Ashish Kothari, Technical and Policy Core Group, Pune, India

Summary: The author outlines the need to conduct research on Europe's impacts on biodiversity of southern countries, especially in two areas: (1) the consumption of goods and services from the south, and (2) the impact of development assistance.

Much of foreign environment/development interventions in southern countries have focused on providing aid or other kinds of assistance. This includes research efforts that have focused on doing research within such countries. While not undervaluing this, I would like to stress the need for Europe to look at its own impacts on biodiversity (and more generally the environment) of such countries, especially in two forms: (1) consumption of goods and services from the south, and (2) impact of development assistance.

In both case, the impacts on the environment of southern countries is considerable, but not fully or adequately measured. Methods like 'ecological footprint' have brought consciousness on the role that northern consumption plays in damaging the environment of the south, but we have very poor idea as yet about the full nature and scale of the impact. Also not fully known is how much the recent changes in consumer or producer behaviour are beginning to reverse some of the negative impacts.

Specific subtopics for this could be:

1. Impact of European consumption of 'primary' products (agriculture, forestry, fisheries)
2. Impact of European consumption of industrial products made from or having an impact on natural resources
3. Impact of European use of services (e.g. tourism)

Similarly, there is indeed quite a lot of discussion and debate on the negative environmental of development aid, especially when such aid is oriented towards large-scale development projects like dams and mines, or leads to increasing commercialisation of natural resources including agriculture. However, again there are no comprehensive studies on the nature and scale of the impact, nor on how changes in development thinking of donor and investment companies are beginning to reverse the negative impacts and maximize the positive ones.

Specific subtopics for this could be:

1. Impacts of aid in large-scale development projects.
2. Impacts of aid in primary sectors (agriculture, forestry, fisheries), especially aid intended to or resulting in commercialisation of such sectors.

In both the above cases, the research should lead to specific, concrete recommendations on what steps European countries (or southern countries) need to take to reduce and eliminate the negative impacts they are having. To my mind these two topics could be extremely useful areas to focus research and action on.

Needs for future cooperative taxonomic research

Wolfgang Wägele, Bonn University, Germany

Summary: To control and stop the changes of biodiversity in the anthropocene, new techniques must be developed and databases must be fed to speed up the assessment of habitats.

In the age of drastic global changes that affect the biosphere in a rapid, uncontrollable and unpredictable way, the need for assessments of biodiversity is urgent. Losses of species are deprivations that will affect the quality of life of future generations. Global warming and land use will lead to mass declines and extinctions and to displacements or disappearance of habitats, but predictions about the extent of these changes must remain speculative as long as no baseline data on the current diversity are available. The importance of species diversity for ecosystem functioning may be paramount but can at present only be addressed for a restricted set of model groups or for idealized functional groups.

The gaps in our knowledge are well known: roughly 10% of all species (possibly less) have been described so far. Of those that bear scientific names only for a minority are some autecological data available. In view of the rapid changes the most urgent task is not to infer phylogenies but to develop tools that allow us to discover endangered populations and to identify valuable landscape fragments that must be protected. It is necessary to speed up inventorying and assessment and to strengthen taxonomy.

It will never be possible to multiply the number of taxonomists for large-scale monitoring, and even for inventorying and monitoring of single observatories the available expertise will remain poor. Several factors cause the taxonomic impediment: (a) Specialists focus on taxa, not on habitats. Therefore they usually do not cooperate in hotspot inventorying but do solitary work in very different geographic regions; (b) Species discovery and identification is a slow progress if literature searches, specimen dissections and taxonomic revisions are involved; (c) The number of specialists is too small.

To improve the situation it is necessary to develop those technologies and databases that speed up (a) access to taxonomic and biogeographic data; (b) re-identification of already known species; (c) description of new species; (d) re-identification of yet unnamed species; (e) quantitative assessment of species diversity. Taxonomists must get involved in large-scale monitoring and other activities that attract funds.

Of the various available methods, the most interesting ones are those that can at least partly be automated, e.g., in the analysis of acoustic signals (identification of birds, bats, frogs), of digital images (identification of bees, flies, butterflies, etc.), and of DNA or RNA. A very important point is to develop the technological ability for quantification of species occurrences. Streamlining the integration of all data into curated databases must be emphasized as well.

The development of technologies is only the first step. Most of the resources must be invested in the application of new methods to establish and link databases, to test new tools in the field and for monitoring of selected sites. This is a monumental task that requires international cooperation. Existing initiatives like GBIF and CBOL

already offer part of the required tools, however, without long-term funding instead of the indispensable momentum a scatter of non-functioning enterprises will paralyse progress.

Re: Needs for future cooperative taxonomic research

Ferdinando Boero, Universita del Salento, Lecce, Italy

I strongly disagree with what Wolfgang Wägele wrote. He says that the number of taxonomists will undoubtedly remain low. And that there are other ways of evaluating biodiversity. This is nonsense. A part of the scientific community is deliberately aiming to cancel taxonomy and replace it with high tech approaches. By the way, what is the accuracy of species identification in gene banks? We spend enormous amounts of money looking for extraterrestrial life or to count the stars in the universe, but we accept that the investment in recognizing the species pool of our planet has to be inevitably poor. Why? What is the rationale for this? Maybe because there are no rocket industries behind? Or maybe because taxonomy journals have no impact factor because zoologists have the Zoological Record since 1864 and do not need to buy the services of ISI and so ISI ignored their journals in the rating of scientific tribunes for simple economic reasons?

The first, and only, duty that God assigned to man after the Creation was to give a name to living creatures. All other jobs were punishments. We have not accomplished this job yet. I am not religious, but I like this idea. And if a Martian visited us s/he would ask us the question posed by Robert May: How many species are there on your planet? And if we answered with the reasoning of prof. Waegele the Martian would surely scratch his or her head (or whatever part of the body where they keep the thinking organ up there) and doubt the value of our way of setting priorities... GBIF and ENBI directed biodiversity money to people involved in Information and Technology and gave peanuts to taxonomists. We used that money to spread information based on insufficient knowledge, showing a great lack of wisdom.

Re: Needs for future cooperative taxonomic research

Christopher Lyal, Natural History Museum, London, UK

I don't think there is any question that there is a taxonomic impediment to many activities in biodiversity research, monitoring and assessment, and, indeed, any activity that requires organisms to be identified so that management or other action can be carried out. This is the basis of the Global Taxonomy Initiative, a Policy Process of the CBD. The issue is how this can be addressed.

I agree with Wolfgang that there are a number of steps that can be taken to make the process of 'doing taxonomy' more efficient. There are a number of rate-limiters in the process, and some of these can be addressed through, for example, informatics tools now being developed and the initiatives, like GBIF, that are making use of them. Some of the tools are for analysis of data, some for dissemination of data, some for interoperability of different database systems and knowledge bases. All well and good, and these developments need to be supported. Some at least are

struggling for funding right now, and if they fail, data currently available on the internet will no longer be so.

Tools and systems to make data available and to analyse those data are vital, but without the data themselves they are of little use. Funding to populate such systems can be extremely difficult to obtain - there is still no complete list of all described species on Earth, let alone their taxonomic relationships and synonymies, and although great progress is being made, there are still large gaps that will not be filled without effort - and effort needs funding. The data available attached to specimens in the world's taxonomic institutions offers many potential benefits for analysis to discover effects of anthropogenic change (as well as speed up taxonomic research), but to do this the data need to be digitised - GBIF currently serves over 100 million observational and specimen records, but there are hundreds of millions more that could be digitised with suitable support, and compelling arguments why this should be done.

When data are collected and made available, there is still a need to make such availability sustainable, and thus exonomic models to allow such sustainability are required.

The outputs of taxonomy are of course key to our discussion. Wofgang is correct to note that priorities for taxonomic research, and the scope of their work, is not necessarily congruent with the needs of the users of taxonomy. The first step is to be very clear about what those needs are, and priorities attached to them. We also need to see to what extent the lack of appropriate taxonomic information (identifications, field guides, lists or whatever) is a limitation on meeting objectives. With that information we can perhaps generate the taxonomic output to meet those needs. I have been depressed to see funding for taxonomic components of agricultural or environmental projects deleted because it is assumed that the taxonomic information will be made available without cost (and then, as a taxonomist, asked to supply such information, as though my time was freely available to anyone who asked for it). In the current economic framework taxonomists, like every other scientist, are required to apply for grants to support their work by almost all employers - in these circumstances, to omit necessary provision for obtaining necessary taxonomic information is, at the kindest, poor project design.

There is a tendency to focus on organisms for which the taxonomic information is relatively good - mammals, birds, flowering plants, for example. However, such organisms operate at different grain size form the far more numerous invertebrates, and arguably will skew environmental decisions unreasonably. I would guess that decisions based on a subset of the ca 4,000 species of mammals might be different from those based on a subset of the ca 70,000 species of weevils, for example - and who anyway would take decisions on the basis of just weevils?

Back to products. Given the vast number of species and the time since some of them were described, there is an undoubted need to carry out basic descriptive taxonomic research. Without this the needs of non-taxonomists cannot necessarily be met. However, there is a gap between taxonomists' research and research outputs at this level and the type of output that non-taxonomists need. In the UK less that half the fauna has ever been covered at species level by a field guide, and many of the extant guides are out of print. Either resources need to be devoted to production of field guides (or similar, remembering that an on-line illustrated key is great, but can be cumbersome to use in the field, and is difficult to use in areas of low bandwidth or no computers), or identify a way in which requisite information, in the appropriate form and language(s), can be produced as a concomitant of other taxonomic research.

Use of automated or semi-automated tools, such as DNA barcodes or sound production, will assist in rapid identifications for monitoring. However, they are not magic bullets. DNA barcodes will only be of value if the barcode species concept can (a) be equated with a species concept, and (b) linked to a named species. In the overwhelming majority of cases, the work required to meet these criteria is not yet done, and will require taxonomic input.

There are assessments that attempt to circumvent the taxonomic impediment by assigning specimens to 'morphospecies' and not formally naming them. This can certainly be effective in some ways, but is difficult to do in a long-term monitoring programme or when comparing different places. Without being able to name the morphospecies, and know ways of identifying them from each other, morphospecies are of limited value - taxonomic input will be needed.

Overall, we need to be clear just what taxonomic input is required for monitoring and assessment, and then ensure it can be delivered though prioritisation, effective project design and funding.

Interdisciplinary socio-economic biodiversity research in Biosphere reserves

Susanne Stoll-Kleemann, Humboldt University of Berlin, Germany

Summary: The author suggests research needs based on the results of the GoBi (Governance of Biodiversity) Research Project.

This keynote address presents results of the GoBi (Governance of Biodiversity) Research Project in which success and failure factors of biosphere reserve management and governance approaches are evaluated (for details please see www.biodiversitygovernance.de). The key research question is under what circumstances the governance and management of UNESCO biosphere reserves can contribute to significantly reducing the rate of global biodiversity loss. The results are based on a broad range of different quantitative and qualitative data sets such as case studies in 9 countries; a meta-analysis and more than 170 detailed expert interviews conducted with people who work in biosphere reserves and other protected areas, such as managers, scientists, and representatives of NGOs. Finally, a global telephone survey was conducted with 210 Biosphere Reserves in 80 countries worldwide (out of the 505 Biosphere Reserves in 101 countries). The collected data covers management as well as legal, institutional, social, economic and ecological aspects relevant for the management and governance of biosphere reserves.

Results

1. Management Issues

In the literature a collaborative, flexible, stakeholder-oriented process is recommend as the potential successful biosphere reserve management approach which at the same time considers local concerns and seeks local ownership and support. The managers interviewed by GoBi researchers reflect a much broader set of perspectives on which of these approaches work best and why others are failing (Stoll-Kleemann 2005a). Often, the reasons are area-specific: Much depends on the need for tough rules to guarantee protection of ecosystem services where the role of protection provides the basis for local livelihoods. In other areas, educated use of the ecosystem services offers a wider range of employment opportunities. Good managers design consultative and participatory procedures that reflect these differences. The issue here is that in many instances, strict protection from excessive use is not politically feasible, despite the strength of the scientific case for safeguarding these sites. Consequently, managers must constantly balance monitoring with negotiation. In this sensitive dialogue, they have to provide options for local users while simultaneously keeping users from destroying the biosphere reserve (Stoll-Kleemann 2005b).

2. Governance Issues

The GoBi Researcher furthermore found that in biosphere reserves problems at the operational levels are closely linked with broader governance issues (Stoll-Kleemann 2005a). This means that biosphere reserves differ substantially in their dependence on the political setting. Biosphere reserve management is subject to conflicts caused by political interests, and frequently, managers have to adapt to a highly politicized environment. Therefore, one critical aspect shaping successful biosphere reserve governance is the degree of political support in national and international policy. One example of an unfavorable political condition drawn from the data is a contradictory pattern of responsibilities among governmental administrative authorities. A second

unfavorable condition mentioned by nearly all of the interviewees relates to the lack of political support at the local as well as national levels of government. Interviewees all required more international publicity toward and pressure on national governments to ensure that they care enough for their internationally designated biosphere reserves. A third aspect of insufficient political support is the resultant lack of funding for managing biosphere reserves. In general, lack of resources strongly inhibits biosphere reserve activities. Public political support for a project without sufficient allocation of funds will never compensate for poor infrastructure, unpaid staff and missing outreach arrangements. High financial insecurity makes planning obsolete and often causes serious conflicts.

The more room there is for the biosphere reserve manager to maneuver politically, the better the possibility to implement rules and longer-term activities adapted to the site-specific circumstances (Stoll-Kleemann et al 2006). Important aspects are the degree of leadership, the financial situation, supporting actors, effective networking, conflicting interests, the national conservation discourse, the constellation of actors, and the general political situation. Though conservation concerns can claim to be of fundamental importance, in daily management they have to compete with several other highly politicized concerns.

Conclusions

Managers of biosphere reserves are still in a process of coming to grips with a demanding combination of inadequate scientific evidence; insufficient monitoring of ecological processes; chronic under-funding; and uncoordinated governmental activities (Stoll-Kleemann 2005a). Biosphere reserves require much more sophisticated management treatment according to the varying practicalities of delivering ecosystem integrity.

Gaps in our knowledge and further research needs

Such projects as described above show that the often-stated requirement of inter- and transdisciplinary biodiversity research is indeed a necessary and legitimate claim. We need much more research conducted by interdisciplinary teams and on the basis of the ongoing participation of all relevant stakeholder such as landowners and land users, decision makers, representatives of NGOs etc. (Stoll-Kleemann and Welp 2006). A further research need is that we need more (meta) data on the level of protected areas and biosphere reserves which is open to all researchers who want to work with it in order to be able to measure the success of conservation measures (Bertzky and Stoll-Kleemann 2007).

Integrated research in Africa: further research needs

Norbert Jürgens, BIOTA AFRICA, DIVERSITAS, GEOSS

Summary: Joint integrated biodiversity research is needed and welcome in Africa; it should however not be planned by Europeans as part of their European programs, but be developed in a participatory way with the African partners as a contribution to sustainable resource use and development in Africa.

During the past years both the value of the African biodiversity as well as the need to develop the capacity for biodiversity research in most African countries has been recognized. The resulting awareness led to the development of joint research programs. However, until today only few programs have developed a highly integrated approach to the various interconnected aspects and challenges of biodiversity research, especially within the BIOTA AFRICA network. An additional number of programs aim at focused academic disciplinary topics or serve specific applied goals, e.g. in the context of development activities.

Gaps in our present knowledge cover a wide spectrum of issues including (a) availability of inventories and assessments of present diversity, integrating innovative methodologies, (b) monitoring and assessment of the change of biodiversity in different biomes, integrating analyses of the potential drivers of change, (c) understanding of the processes and mechanisms which govern change of biodiversity, (d) analysis of the consequences of changing biodiversity for ecosystem functions and for services to local, national and continental economies and society, integrating the economic equivalent of these changes, (e) science-based strategies and tools for sustainable management and conservation of genes, species and ecosystems, (f) socio-economic and policy concepts for a realistic and feasible transformation from present exploitation practices to sustainable land and resource use regimes and governance patterns, (g) communication and learning partnerships with resource users and other stakeholders at the levels of households, farms, villages, nations and regions. Many of these topics have been studied within regional contexts or good case studies have been provided, already. However, an integrated view with sufficient coverage of the African continent still needs to be developed and should also react to the recent and threatening climate change predictions.

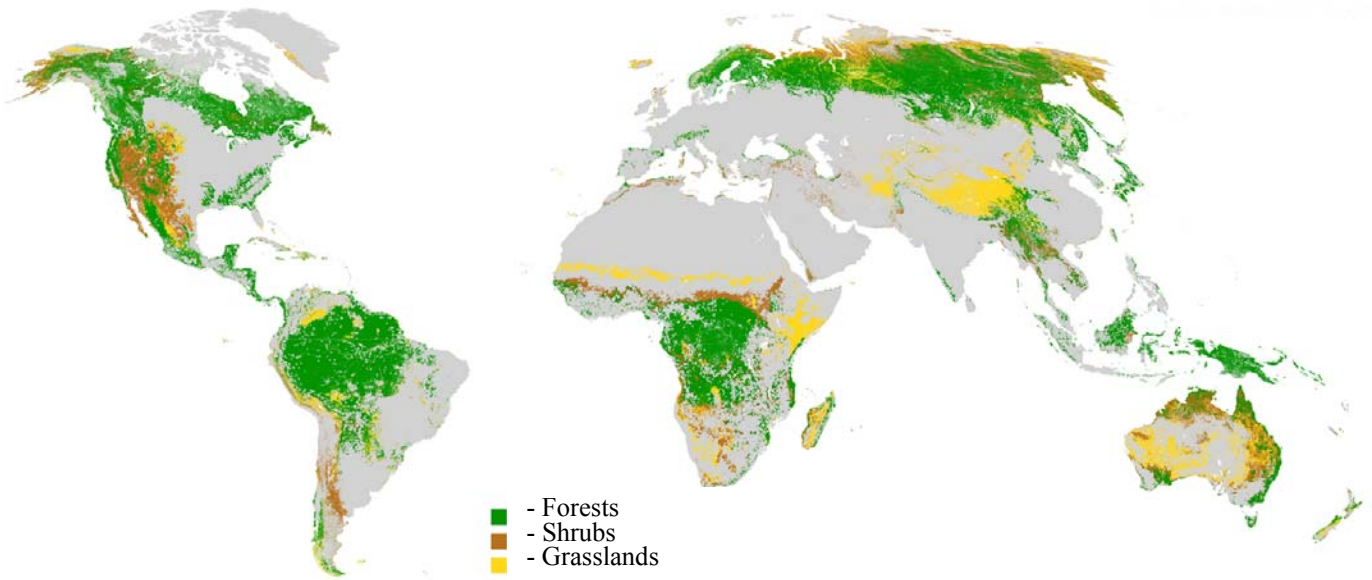
I hold it for self-evident that the complex interaction of dynamics of genes, species, and ecosystems with human resource use, economics and social, cultural and political perception need to be understood and discussed in an integrated way, amalgamating knowledge on the dynamics, rules and services of the living nature on our planet with political pragmatism aiming at human welfare in a sustainable ecological and economic future. It is very obvious that our baseline knowledge of the many mechanisms and consequences of change of biodiversity in the numerous and diverse global ecosystems is still very limited. To a large extent this is due to a lack of data documenting the different types of change of biodiversity. Given the diversity of African biomes and ecosystems, the development of an African biodiversity observation network, which integrates research for innovative approaches to sustainable resource use, could be a far reaching strategy for future research. Additional momentum for such a strategy is created by GEOSS, the Global Earth Observation System of Systems.

Megadiversity vs. keydiversity

Elena Bukvareva, Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, Moscow.

1. Expanding the coverage of "global perspective".
Traditionally the general direction of the "global perspective" is from Europe to tropical areas and developing countries. I believe that coverage of "global perspective" must be expanded. Today there are four main realms of natural ecosystems in the Earth (see fig.1): two boreal realms (North-American and North-Eurasian) and two tropical realms (South-American and African). The other larger parts of the globe have no productive natural ecosystems (arid territories, highlands, ice, man-transformed areas). These four main nature realms provide the most part of biosphere regulation. They are key territories for biosphere stability and "global perspective".

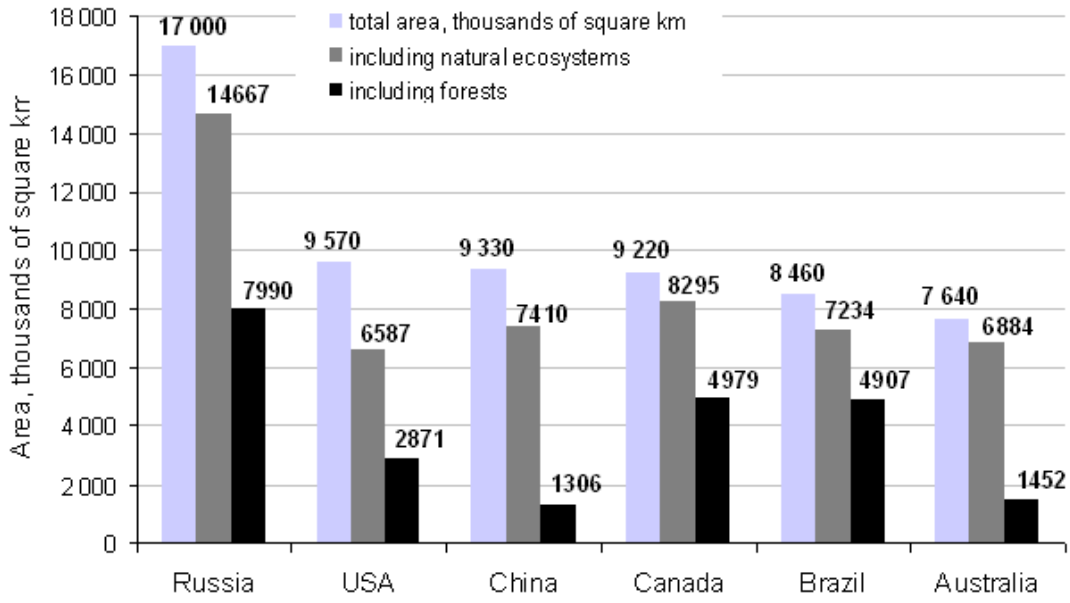
Figure1. The largest massifs of surviving nature ecosystems



Sources: Global Land Cover 2000 and Millennium Ecosystem Assessment 2005

In terms of politics there are three countries that are responsible for conservation of the largest massifs of productive natural ecosystems: Russia, Canada and Brazil (fig.2, based on data of the GEF project "Conservation of Biodiversity of Russian Federation"). The African nature realm is divided between many countries. In fig.2 the black bars show forests – the land ecosystems which are the most important for biosphere regulation. Russia, Canada and Brazil are responsible for conservation of the largest forest areas and providing its biosphere functions. These countries are key elements of "global perspectives". Stability of biosphere first of all depends on nature management in these countries.

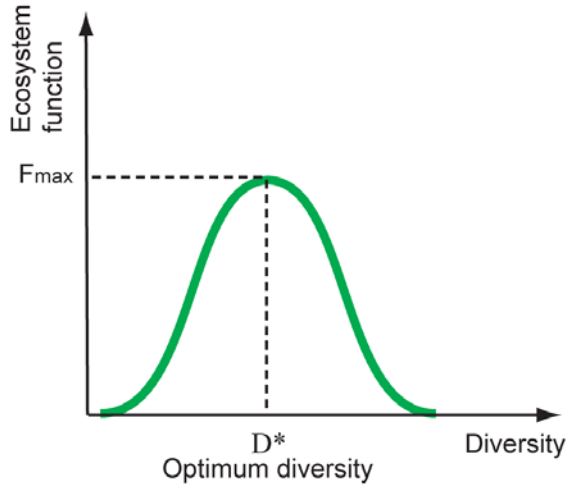
Figure2. Countries that are responsible for conservation of globally-significant nature massifs



2. “Megadiversity” vs “Keydiversity”

Species diversity is essential, but not the most important criterion for prioritisation of life-supporting functions of ecosystems. Undisturbed nature systems (ecosystems as well as species and populations) have optimum levels of diversity (species diversity, intraspecific and intrapopulation diversity, accordingly). Optimum levels of diversity provide the most viability of a biosystem and the most effective ecosystem functioning (fig.3).

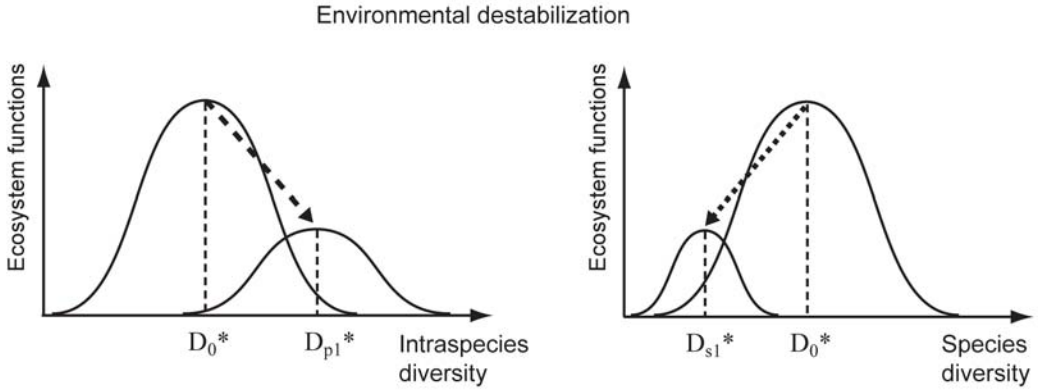
Figure 3. Optimum biodiversity and ecosystem function



The value of optimum diversity depends on environmental factors and properties of the biosystem. When we compare evolutionary similar biosystems the most important factors are stability and “richness” (intensity of resource flow) of the environment. Our modelling researches show that species diversity and intraspecies diversity

change in opposite directions when environmental instability increases. In more unstable environment species diversity decreases, but intraspecies diversity increases (fig.4). There are many empirical studies of this pattern.

Figure 4. Changes of optimum levels of biodiversity when environment becomes more unstable



This result may be interpreted as redistribution of regulating functions between diversity in two adjacent hierarchical levels – biocenosis (with species diversity) and species (with intraspecific diversity). Thus, in more unstable environment significant part of regulatinf functions pass from species diversity to intraspecies diversity. Such is indeed the case in relatively unstable and "severe" boreal biomes. Taxonomic diversity per se can't serve as criterion of effectiveness and stability of ecosystem function. The criterion is the natural state of ecosystems and species which have the optimum levels of diversity. Undamaged by man ecosystems are key elements of global regulation. That is we need to speak not about "megadiversity" regions and countries, but about "keydiversity" regions and countries.

3. Cataloguing at the time of fire

Inventory and cataloguing of biodiversity is necessary and important activity. But… against a background of global and massed destruction of biota it looks like demand to hurry up with cataloguing of books at the time of fire in library… Today incompleteness of our biological knowledge can't be an obstacle for nature conservation. The main barriers are socio-economic and political factors: poverty, wrong income distribution, lack of political will, human population explosion…etc. What is the matter – biologists don't know what to say? Other people (politicians in the first place) hear them badly - therein lies a problem!

4. Tropical and boreal biodiversity: competition for attention of investigators

As regards identification of biodiversity - it is far from complete, and not only in tropical areas. In boreal ecosystems, the main taxons which play key ecological roles (protists, fungi, lower plants, many groups of invertebrates) are not adequately explored. Exact numbers of species in these taxons is unknown. But it is only a part of problem. As mentioned above, in boreal ecosystems a substantial part of regulating functions passes from species diversity to intraspecific diversity. In the north, loss of any geographic or ecological form of a widespread species will lead to great degradation of ecosystem functions – just as loss of a species will in tropics. Have we got full information about intraspecific diversity of boreal species? This question is rhetorical.

Experiences from German-Brazilian cooperation

Christoph Knogge, Helmholtz Centre for Environmental Research UFZ, Leipzig, Germany and **Karl Wantzen**, University of Konstanz, Germany

Summary: The authors draw on their experiences of bilateral co-operation projects to suggest further research needs relating to taxonomic work, interdisciplinary research and the development of tools to better develop sustainable management options.

Within international scientific co-operations between Germany and Latin American partners Brazil represents the most important one. Since 1969 the co-operation is based on contracts for scientific research and technological development that are continuously renewed and diversified in research programs that cover a wide range of disciplines that besides foster basic scientific knowledge research, follow an application-targeted approach that contributes to a sustainable development and the management and conservation of natural resources. Here, we focus on two experiences for the bilateral co-operation that cover biodiversity research as well as the development of land use and land planning management tools, the SHIFT program (1998-2001, acronym for Studies on Human Impact on Forests and Floodplains in the Tropics – see Nunes da Cunha et al.2004 for a review of the achievements of the Pantanal-project within this program and –more recently – the "Science and Technology for the Mata Atlântica" programme (www.mata-atlantica.ufz.de).

The experiences of collaboration programs with Brazil shows that there is a very high potential for international biodiversity research to be productive and effective because of synergistic processes. For example, long-term cooperative research in aquatic biodiversity has recently yielded a reference book series "Aquatic Biodiversity in Latin America" (ABLA, see www.mpil-ploen.mpg.de/mpiltaci.htm). Another important result is the joint development of training courses, e.g. the MSc. course in "Ecology and Conservation of Biodiversity" at the Federal University of Mato Grosso and the Pantanal Research Centre (www.cpp.org). Sound conditions for basic research as well as for a sustainable development and conservation of natural resources include institutional, financial, legislative and coordinative conditions in scientific, technical and communication questions.

Future biodiversity research requires a highly integrative and multidisciplinary approach and essentially needs long term and sustainable financial support and activities. Effective biodiversity research that aims to contribute to the 2010 targets and further essential conservation goals depends on the successful integration of different areas such as:

- Taxonomic work: basic description, classification and species inventories, monitoring, data sharing
- Basic interdisciplinary research for understanding socio-economic and biological predispositions and processes affecting biodiversity on different scales (socio-economy, landscape ecology, organismic ecology- population dynamics etc…)
- Developing tools for modelling future scenarios, for management and preventive land use planning, management of biodiversity on regional scale, management and development of techniques of land use systems and use of natural resources

- Capacity building, developing sustainable application programs, infrastructure and institutional co-operations and commitments with long-term perspectives

For successful realization of biodiversity research and its application following conditions are essential:

- Long term and confidence based international co-operation commitments on different levels between ministries, funding agencies, research institutions, and scientists
- Development of institutions that facilitate communication between administrative authorities for wildlife conservation, agronomics and land use, national, and local NGOs, and public decision makers
- Legislative environment that enhances international non-profit oriented scientific cooperation (exchange of data, technical and biological material)
- Long-term financial programs for multidisciplinary research co-ordinated with technical co-operation programs financing sustainable application

Life-long biodiversity education

Mauri Ahlberg, University of Helsinki, Finland

There has been plenty of writing about ecology and economy, but none or very little about importance of lifelong Biodiversity Education.

I remind you about Helsinki e-conference, in which there was a session on Biodiversity Education.

Many of the issues and problems that have been raised could be solved by one of the end result of Helsinki e-conference: network of NatureGate(R) servers. The first on will be opened this year by the financial support of University of Helsinki, ESRI and Nokia. The pilot will be demonstrated in Leipzig Biodiversity meeting. This approach does not compete with other kinds of Biodiversity research, because it gets its money from companies. However, it will provide enormous amount of biodiversity data, if biodiversity researchers are ready for it. We need win-win strategies, international cooperation to we biodiversity loss. In Leipzig and elsewhere we are seeking for long-term win-win collaboration.

Session III: Biodiversity and ecosystem services: The Millennium Ecosystem Assessment concept from a European Perspective

Session III Introduction: Biodiversity and ecosystem services: the Millennium Ecosystem Assessment concept from a European perspective

Carsten Neßhöver and Kurt Jax, Helmholtz Centre for Environmental Research UFZ, Leipzig, Germany

The strongest outcome of the Millennium Ecosystem Assessment (MA) has been its framework which explicitly connects ecosystems and human well being by addressing a number of services that ecosystems provide, as well as including drivers which cause the reduction of these services (MA, 2005). This framework has proven, within a short time, its usefulness for linking the preservation of ecosystems more directly to different policy fields. For example, the concept was incorporated into the recent EC-communication on halting the loss of biodiversity until 2010 and beyond (COM (2006) 216).

Interestingly, ecosystem services are strongly used in reasoning for biodiversity in the EC-communication, but the concept is rarely reflected in the actions that are proposed in order to stop the loss of biodiversity. These actions are mainly bound to classical policy measures (e.g., CAP, cross-compliance), to specific ecosystems (e.g., freshwater) or specific threats of biodiversity (nutrient loading, climate change). This is an indication that although the ESS framework is suitable for arguing for ecosystem integrity and biodiversity, its integrated approach is currently not used in policy. Thus, research has to provide the tools and measures to operationalise the concept.

A multitude of case studies for ecosystem services on different levels and regions in Europe exist, which are already developing different approaches for operationalising the ESS concept. Some of these will be presented during the course of this e-conference. But what seems to be lacking is a coherent framework which links these approaches and the general ESS concept, and which identifies how the concept could be linked more directly to policy needs and future policy measures.

Another aspect in this context is the multi-level perspective that is needed to address ESS: When looking at the local level, it might seem quite easy to identify the services that are most important for the local people (e.g., agricultural use and water purification in floodplains) (Beck et al. 2006). But if interests on other levels are included (e.g. flood protection and recreational value), this prioritisation becomes much more difficult. Who selects the services? Who decides? On which level? How are different material and non-material values related to different services balanced? By which institutions and procedures? This example indicates that governance aspects (including questions of public participation) and questions of ethics become very important and that a multi-scale approach is needed for future research as well (Schröter et al. 2005; Capistrano et al. 2005).

To summarize, we see the future research needs on ecosystem services and biodiversity in the following fields:

- Testing the applicability of main MA framework aspects in a European context
- Evaluating existing policy measures for their applicability within the ESS concept
- Improving evaluation tools for ESS (including ethical ones)
- Analysing the shortcomings of the ESS concept in the context of biodiversity conservation and the intrinsic values of biodiversity
- Developing participative methods for selecting the most relevant ecosystem services and deciding about priorities

- Developing a framework for a multi-scale assessment across Europe – from the local level to a pan-European scale
- Improving knowledge on the link between ecosystem functioning and ESS (e.g. up-scaling issues, different notions of proper “functioning”) (as link to Session II of the e-conference) Effects of European consumption of ESS in other parts of the world
- Addressing uncertainty of the provision of ESS under changing land use and climate change

MEA and SBSTTA: 4 questions for you

Martin Sharman, European Commission, Brussels, Belgium

The CBD's Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) will next meet in Paris on 2nd – 6th July. I think we can foresee that in the light of the MEA, SBSTTA will probably recommend that:

1. We should undertake MEA-like national and sub-regional ecosystem assessments (as well as a global assessment in 2015). Is this a scientifically useful idea? How should these assessments be designed and co-ordinated? How should European scientists contribute?

2. We should introduce coherent global standards governing how data are collected and integrated. Do you think that this is possible? How should we set about establishing and agreeing on standards?

3. There should be free and open access to all public-good research results on biodiversity. Participants in EU Framework Programme projects are encouraged to patent their discoveries as far as possible, making it less than straightforward to stipulate in the grant agreements that data from the project should be made freely available. In the spirit of what SBSTTA will probably say, and in the light of the GBIF recommendation on open access to biodiversity data (http://circa.gbif.net/irc/DownLoad/kqepAOJBmrGtp9ppb4pqRBjR5BmFFEvH/yo6c_mTv3OnSpFYd1G/Recommendation.pdf), do you think that proposals for publicly-funded research should automatically include a provision for making data available after a certain delay for publication?

4. We must communicate the findings of the assessment to a wider audience than the scientists involved. How do you think that this should be done? Who should do it, and how should it be financed?

Re: MEA and SBSTTA: 4 questions for you

Felix Rauschmayer, Helmholtz Centre for Environmental Research UFZ, Leipzig, Germany

I give my answers subsequent to your questions.

1. MEA-like ecosystem assessments have their main scientific contribution on a meta-level. They help to strengthen interdisciplinary research aimed at actual societal problems. Still today, most biodiversity research is only loosely related to societal problems due to biodiversity loss and change, and it is quite difficult to deduce clear policy recommendations from this research. Undertaking MEA-like assessments is scientifically challenging because it demands the creation of new links between separate fields and disciplines - these create new demands of natural scientists to take into account policy more, and to co-operate more with social scientists, and they create a new demands for social scientists to work on biodiversity and ecosystems. Therefore, it is important to design and co-ordinate these assessments in close co-operation between natural and social scientists, integrating policy-makers (in a wide sense) in the design and implementation of this research.

2. Here, MEA clearly showed that establishing global standards is contrary to their policy-relevance, especially on sub-national levels. It might be possible to create

regional standards in a culturally quite homogeneous region such as Europe. Doing this all over the world means to lose policy-relevance and interdisciplinary integration between social and natural scientists - the main strengths of MEA-like assessments in my eyes.

3. Yes. As a social scientist, I don't have a personal problem with it, and even more, in general, knowledge created through public money should be usable publicly.

4. In science, we still think to little about the outreach of our research. As in business, where the design of a product depends on the needs of the customers and on technical feasibility, we have to consider in our research design the needs of our customers, i.e. of the policy makers (in a wide sense) willing to make substantiated decisions on ecosystems, and to better consider the impacts on ecosystems of other not-directly ecosystem-related decisions. This means to integrate decision-makers in the design of our research, and not integrate them once the research is done. Secondly, this means to employ specific means and persons for outreach, and not let the same people who aim to publish in peer-reviewed journals or who aim to be as much as possible in the field or laboratory, do the outreach, but those who love to do it, and who are skilled to do it. Thirdly, this means some meta-research on science/policy interfaces: how to avoid that stakeholders get fatigued of participation in research projects? how to co-ordinate between research projects at the same and at different levels? How to identify windows of opportunity to insert scientific knowledge in political decision-making processes (at different levels)? ...

Re: MEA and SBSTTA: 4 questions for you

Mirilia Bonnes, University of Rome La Sapienza, Italy

I read all these contributions and I found all of them very interesting and very rich... probably too rich for finding easy conclusions! Anyway I would like to make only a short comment in order to reinforce what Felix Rauschmayer said in his contribution, about the importance of inter-disciplinary collaboration between natural and social sciences. I agree with him in considering this aspect as the most crucial and also the most challenging (..and thus still not enough developed!) for dealing with the main problems here under discussion .

Re: MEA and SBSTTA: 4 questions for you

Ferdinando Boero, Lecce University, Italy

Here are some answers to Martin's stimulating questions.

In terms of undertaking MEA-like national and sub-regional ecosystem assessments, the idea is very good. There are some problems. The first is to agree on what is an ecosystem. It is not even very clear what is a Habitat in the Habitat directive (especially for marine systems). If I look at the rationale of the ecosystem approach enforced by the EU for fisheries, I see that their idea of an ecosystem is not the same as mine.

My first question is: do we know the distribution of habitats in the seas and oceans of Europe? The answer is no. The other question is: do we know the distribution and boundaries of ecosystems in the seas and oceans of Europe? The answer is again no. We know some bits. Science goes on by describing patterns and

then by understanding the processes that lead to these patterns. We do not know the patterns but we want to infer on the processes. To use a mild adjective, I can only say that it is unwise.

We need standards on WHAT are the data to be collected and then on HOW they are stored. Data should be asked for and stored just as the financing is asked for and stored.

In terms of communicating results of assessments, the Italian ministry of the environment is using some of its money to support TV programmes in which a nice journalist explains to the public all the nice things that are being done, for instance, in Marine Protected Areas. There are interviews to scientists, and the packaging of the information is so that the public can understand. The way things are publicized is the TV: It is the most powerful one. Some funds have to be used to spread these information through the TV, with dedicated programmes. The same approach could be taken to communicate the results of an ecosystem assessment of Europe.

Re: MEA and SBSTTA: 4 questions for you

Petr Petøík, Institute of Botany, Academy of Sciences of the Czech Republic

First I would like to answer the third question of Martin Sharman. The question is not only how to introduce global standards for data collecting (I agree with Ferdinando what these data are is also important) but also how to analyse them. There are many numerical approaches for data analysis and if I want to analyse my data and publish in peer-reviewed journal, I must cooperate with some statistician or GIS-specialist – i.e. teamwork. However, I am not able to understand everything in statistics or GIS and this is not an ideal situation for me. I think we should rely on our own experience, not only on "black-box" methodical tools. Our own experience is of course very necessary and non-transferable in data interpretation and methodical obstacles should not obscure it.

I say yes to free and open access to all public-good research results on biodiversity (Martin´s question 4). This is the goal e.g. for GBIF. The primary data should be an obligation for publishing in some journal. But many scientists do not want to show their results intentionally. Are they afraid of misuse or checking of their results? And what about a scientist who is looking for some published results? He has to pay for access to read papers in international journals or even to publish in them! For me, to read news from the Science magazine I have to ask authors for it, sometimes they send me it, sometimes not. But is it really an open science? This reality is maybe due to problems in funding science (the low input of money was recently criticised by Google founder Larry Page).

Here, I must agree with Ferdinando on setting standards how the data are stored. It is very important for data exchange (XML format etc).

In general, we scientists (I am geo-botanist) are still relatively unskilled in dissemination of our results into wider audiences (I like Ferdinando´s recommendation for using TV as one information vector). It consists maybe in our reluctance against writing in understandable way, because we often lack contact with decision-makers. I am glad to read Felix´s opinion on integration of decision-makers in the design of our research and on some meta-research on science/policy interfaces.

Here are my conclusions:

- For us as scientists: Let us try to do our projects including decision-makers to present our data to wider audiences with respect to all possible applications. Let us interpret our own results unambiguously and offer them being freely available.
- For decision-makers: Try to participate with scientists.
- For politicians: Give more money for science.
- For journal publishers: Call for primary data from authors and for wider interpretation of scientific results. Allow free access to all published papers in journal.

4 questions and other opportunities

Robert Kenward, Centre for ecology and Hydrology, Dorset, UK

There have been a number of really important issues raised in this conference. The questions raised by Martin Sharman, the reminder from Andrew Stott about IMoSEB conclusions and the comments of Alison Holt on MEA in a European perspective all got mauve highlight on my running list of messages. All 3 messages are linked by socio-economic considerations and consequent opportunities.

Regarding ecosystem assessments, there is a risk of creating categories which become silos, between which biodiversity can fall down the cracks. This is especially the case when one starts from a perspective of saving biodiversity by protecting areas that fall into particular categories. For example, heathland is good breeding habitat for ground-nesting birds like nightjars because it is so poor for many other species that nest predators are sparse; even nightjars travel large distances to woodland and meadows elsewhere to feed, and may therefore obtain limited benefit from concentration on one system. Perhaps a bottom-up disaggregated approach, from which findings can later be collated into systemic categories as required, would give greatest flexibility.

Regarding data standards, these are likely to emerge through adoption by the many data collation systems currently being developed. Setting standards risks penalising (a) innovation of better standards and (b) innovative systems that have started with the use of something different. There are many considerations, concerning degree of information detail, ease of storage, transmission and extraction, such that the best standards may vary with circumstances and change with time. Those promoting competing systems will of course lobby for their standards to be adopted and enforced. The most important contribution from an impartial Commission may be to encourage multi-way translation of formats and especially backward compatibility.

Regarding IP, flexibility for different funding and usage models may be wise. Data obtained with public funding should probably as a rule be open-access (if necessary with extraction fee) after a collector-as-author interval. Data won with private funding is different. Value-added products from data interpretation should be saleable, after negotiation on costs if publicly commissioned. UK meteorological data is free, but weather forecasts are not. Map data from privatised Ordinance Survey is free for research but costly for any commercial involvement, which is a problem for mixed-funded start-ups. Maybe the privatisation should have included an open-access-after-reasonable-commercial-interval clause. Constraining IP of products and processes that can raise private income is unwise because it can kill further development.

Regarding communication, perhaps more emphasis on it being a two-way process? It may be important to empower communication of knowledge and ideas upwards, from the local people who make the myriad daily decisions that change land-use and hence biodiversity. After all, there were millennia in which environmental governance was largely local and sustainable. There were strong messages on this in the governance principles and guidelines from Malawi (Ecosystem Approach) and Addis Ababa (Sustainable Use), adopted by CBD in Kuala Lumpur (and thank you Jose Soberon).

So perhaps the answer to all 4 questions is 'stay flexible to permit innovation'. This principle, and a private/local perspective, may also help address a major challenge that follows from Alice Holt's comments on ecosystem services. Recreation from biodiversity cuts across production and cultural services (see CBD Articles 10 and 11) and is associated with huge spending of individuals on wildlife-related activities. Regular US surveys show that this reached 108 billion dollars in 2001, and a survey in UK estimated income value (less than spending) at a quarter to half that of agriculture (www.iucn.org/themes/ssc/susg/docs/WildLivingBrochure05.pdf). This begs another question: how can improvements in research and governance help us achieve best value for conservation from private use of wild resources in Europe?

MEA and SBSTTA: Another question

Andrew Stott, Living Land and Seas Science Division, Defra, Bristol, UK

I have another question to add to the four listed by Martin Sharman. In December 2006, the Executive Committee for the consultative process for an International Mechanism on Scientific Expertise for Biodiversity (IMoSEB) identified a set of needs for improved scientific inputs into international policy (see www.imoseb.net/information_center). These are reproduced below.

My question is, how far could proposals for MA-like national and sub-global ecosystem assessments and common data standards, data sharing protocols, related governance structures etc, leading to a further global assessment in 2015, meet the needs identified by the IMoSEB consultation process?

Needs identified by IMoSEB consultation:

1. To bring insights from the relevant sciences and other forms of knowledge to bear on local/national decisions that affect biodiversity where those decisions have international consequences, and where existing decision-processes appear to be relatively ill-informed by science and other forms of relevant knowledge (e.g. on transmission of invasive pests and pathogens, and exploitation of common pool resources in areas beyond national jurisdiction.)

2. To provide independent scientific information from all relevant sources to support the work of international conventions and institutions, with particular emphasis on the CBD.

3. To enhance our capacity to predict the consequences of current actions affecting biodiversity, drawing on the sciences of both natural and social systems.

4. To provide, proactively, scientific advice on emerging threats and issues associated with biodiversity change identified either by science, and to be responsive to concerns about potential threats expressed by stakeholders.

5. To communicate scientific results on biodiversity to wider relevant audiences.

6. To provide scientific support to existing biodiversity and related monitoring and assessment exercises, and potentially to supplement these as necessary.

7. To reduce the time lag between the publication of scientific results on biodiversity and their incorporation in decision-processes.

8. To inform science and science funding agencies about biodiversity research priorities implied by decision-maker's concerns.

Re: MEA and SBSTTA: Another question

Thomas Koetz, Autonomous University of Barcelona, Spain

Related to the ongoing discussion on MEA, IMoSEB and other science-policy interfaces for biodiversity governance, I would like to present some remarks of more general concern.

One of the main objectives of a global science-policy interface on biodiversity should be the production of a shared cognitive foundation for global biodiversity governance, i.e. a shared understanding of and knowledge base on what we are dealing with in global biodiversity governance.

Biodiversity governance, initially conceived as nature conservation, has moved far beyond this narrow concern: As incorporated through the CBD, biodiversity governance sets out to "profoundly reshape the relationships between humans and nature, as well as the distribution of social, cultural, political and economic rights, responsibilities and benefits among and within States" (Le Prestre 2002: 93). In the political, social, cultural and ecological context, biodiversity has emerged to mean much more than what was captured by its original biological conception. As a result the concept of biodiversity is reclaimed or rejected as belonging to many different competing knowledge domains.

Often, claims made in support of science-policy interface on biodiversity (as e.g. the list of needs proposed by the IMoSEB consultative process) reflect a perspective that see the current impasse of biodiversity governance in terms of either a failure by scientists to communicate their concerns effectively or the unwillingness of political leaders and the public to take necessary actions.

However, taken the evolution of the issue of biodiversity into account the current insufficiency of biodiversity governance might also be perceived in terms of a mismatch between the knowledge offered and the issues it is supposed to help solving. Perceived in this terms it would be essential to acknowledge that the scope of what biodiversity (relevant) science might be has broadened considerably, and to consequently address and produce knowledge relevant to the many issues biodiversity governance is struggling with. This also means that science for biodiversity policy needs to embrace the fact that biodiversity is an inextricably value-laden concept (certainly in its 'new' meaning), instead of hiding behind the role of an 'independent' provider of information.

In order to achieve a shared cognitive foundation for global biodiversity governance, any proposed mechanism/process/assessment is challenged to redress such mismatch. To do so they would need to provide structures that take into account and provide knowledge on all the societal, political, cultural and scientific controversies biodiversity governance is struggling with, while also acknowledging and making transparent the values, ethics and interests behind, and allow for negotiation of, different standpoints.

If well designed, processes such as MA-like national and sub-global ecosystem assessments could certainly contribute to the production of a shared understanding of and knowledge base on what is at stake in global biodiversity governance. Reacting to the question raised by Andrew Stott, I would like to stress the importance of being a bit more critical about the way needs are defined and keep the overall objective of such mechanisms/processes/assessments in mind, before assessing whether such exercise would fill the needs raised by the IMoSEB consultative process.

Linking MA, IMoSEB, and policy

Carsten Neßhöver, Helmholtz Centre for Environmental Research UFZ, Leipzig, Germany

Andrew Stott's question is a rather complex one, since the points outlined for IMoSEB can barely be met by one "type" of scientific procedure or body. Some points, as outlined in the discussion already, might be point excluding themselves to be tackled together (especially setting standards vs. finding local/regional relevant solutions). Maybe some lessons learned from the MA can help to clarify some points (with the view on assessments, not on data-sharing etc.):

1.) The MA originally intended to have a complete set of sub-global assessments which cover scales and biomes more or less systematically- this turned out to be unrealistic so the rather diverse set of sub-global assessments (SGA) developed from a bottom-up approach. Unfortunately, not all SGA were finished when the global MA reports had to be written, so input from SGA to the global level where incomplete - and since at least a general framework connecting the SGA was missing (besides the MA-concept from 2003), it was hard to develop overall conclusions from them (see Capistrano et al. 2005 for details).

So if we could come up with a more complete scheme of SGA for Europe - ranging from a set of local and national assessments to a European one which are more tightly fitted together by a common approach, the outcome would help much more - for Europe and for the global perspective. The challenge is to find the right balance between a common approach and localized (and national interest driven) approaches for every single assessment.

2.) The needs which could be met (IMoSEB points):

ad.1) Since assessments are meant to be interactive between scientists and stakeholders, they are also aimed at providing "ownership" by the involved people (e.g., The initial impact survey of the MA states, that commitment to the MA-concept was highest in countries where an SGA had been performed, Reid (2006)) - so they should in general be able to better communicate science to stakeholders

ad.2) The "independence" of science would be an own topic to discuss... assessments will surely not be independent

ad.3) Predictability (including capacity for adaptation) will be enhanced since assessments will strengthen the knowledge for the complex systems we are dealing with

ad.4) Proactive scientific advice on emerging threats is a different challenge which needs other processes

ad.5) As stated above, communication would be enhanced by engagement of stakeholders, but an additional communication strategy is also needed for every assessment (a thing that the MA lacked to some extend)

ad.7) reduce the time lag between publication and their incorporation in decisions - I don't see how this can be, in general be done. The influence of "normal" scientific results into policy depends on its proven value for policy- and this will normally become visible only with time and increased application of the "new approach". Assessments are another case: They are designed and meant to do this input directly: But they are also another kind of science than the normal "publication science".

ad.8) This is, I guess, exactly what EPBRS is doing... as interactive assessment of research needs between policy actors and scientists.

Challenges in quantifying ecosystem services

Martin Sykes, Department of physical geography and ecosystems analysis, Lund University, Sweden

Summary: The author sets out the challenges and current approaches in place to improve the quantification of ecosystem services.

The MEA classified ecosystem services into four broad classes: provisioning, regulating, cultural and supporting services. Biodiversity in itself has intrinsic value but at the same time is intimately linked with the delivery of these ecosystem services to humanity. Given the increasing rate of loss in biodiversity at all scales a greatly improved understanding of the relationships between ecosystem services and biodiversity is fundamental for the long and indeed the short-term survival of the human species. Much has been written about ecosystem services, but often it is vague with regard to the service and its relevance to humanity but also about interactions between a service and biodiversity and additionally to any negative or indeed positive role global change drivers (Sala et al. 2000) may have in the future.

A part of the problem (possibly a large part) concerns the concept of ecosystem services and how to quantify or make tangible a particular service and devise a relevant unit of expression. Provisioning services such as food and timber seem at least on first glance to be easier to quantify and value than cultural services such as spiritual or aesthetic values. However production in the former is closely linked to a hierarchy of different services as well as to global economics and the somewhat random nature of human behaviour and thus real quantification remains elusive. Further the latter (cultural services) are no less important for the well being of humanity, and in fact some may say they are what makes us human. Even quantifying regulatory services is not straightforward, feedbacks from the ecosystem on climate for example are highly complex, are clearly happening and could be the major player in the rate of future climate change, yet our attempts to quantify them are primitive at best.

We may be able to identify at least in part the major drivers of change for ecosystem services, but we understand substantially less about the real effect of loss of some of these services for an ecosystem and thus for humanity.

How should we try to improve our quantification of ecosystem services? Blavanera et al. (2006) suggest that generalisations among ecosystem types and properties is not sustainable and that consideration should be given to the way in which biodiversity is defined and the disentanglement of the multitude of separate elements and interactions with the environment is required. Diaz et al. (2006) highlight that altered functional relationships within communities are likely to influence ecosystem services most dramatically and thus quantifying these relationships must be important. Luck et al (2003) promoted the idea that understanding changing diversity at the population level as well as at the species level is directly applicable in assessing the value of an ecosystem service to humanity. Thus by identifying biological units that provide specific services we can define in specific circumstances the value of biodiversity to a particular service. This approach is being tested in a current EU concerted action project - RUBICODE (www.rubicode.net).

One might conclude therefore that the way forward is probably through choosing specific examples at the right scale. To do this we could go out and collect some data on these relationships and elements, many ecologists like collecting data, either in the field or through experiments, they seem to feel that measuring or sampling something in some ecosystem and amassing a large datasets gives them a real understanding about how an ecosystem functions. This process may give insights or it may not. Data collection can be useful (and long-term data can be especially useful when trying to understand change – even if the original reason for the collection is lost in the mists of time) but can also be a waste of time. Data collection should therefore have a health warning. Another approach is through modelling of ecosystems and biodiversity (with and without data). There are many models and some explore possible outcomes for ecosystem services, but often the scale may be wrong for the question or application, processes may be too simplified, the uncertainties too many, the outputs may be quantified but the ecosystem service being modelled may not. Few modelling exercises currently give clear directions in response to complex policy questions.

The challenge may seem simple but addressing that challenge is difficult and involves carefully selected cases at the right scale, combining experiments, data and models, within an integrated approach around the relevant science and socio-economics at scales that are determined by policy requirements, rather than by the scientists.

There is no holy grail with regard to a generalised approach to the quantification of ecosystem services and their relationships with declines in biodiversity, now or in the future.

Ecosystem services as a tool to conserve biodiversity

Alison Holt, University of York, UK

Summary: In order to use the ecosystem service approach as a tool to conserve biodiversity we need to better understand the relationship between biodiversity and ecosystem services, and to collate suitable data, across the natural and social sciences, to assess the sustainability of ecosystem service provision and consumption.

An ecosystem service approach recognises that humans are an integral part of ecosystems, they are drivers of biodiversity change and suffer the consequences of it. There is an inherent assumption in this approach that biodiversity supplies ecosystem services, and that the degradation of ecosystem services results in a degradation or loss of biodiversity. Given this, one might expect that conserving ecosystem services would in turn conserve biodiversity. However, this may not necessarily be the case.

Despite the realisation of the potential importance of an ecosystem service approach for conservation, there are some fundamental gaps in our knowledge regarding the ecological relationship between biodiversity and ecosystem services. A key question for the research community, as well as for policy makers and stakeholders, is how might future changes in biodiversity affect the supply of ecosystem services at societally relevant spatial scales? Another, is how does unsustainable consumption of, or demand for, ecosystem services affect biodiversity? Whilst there have been considerable advances in understanding the relationship between species richness and ecosystem processes, the linkages between biodiversity and the provision of ecosystem services are less well established. It is important to consider how biodiversity is being defined. If biodiversity is defined in the broad CBD sense, and refers to ecosystems and habitats, biodiversity and ecosystem services may be intimately linked. However, if it is defined as species richness it is harder to appreciate a link between biodiversity and ecosystem services. A service-led approach to understanding the link between services, functions and different components of biodiversity (e.g. functional groups, habitats or ecosystems) may be more useful.

It is also not clear if our existing methods of biodiversity conservation will effectively conserve ecosystem services, given the pattern of their supply and consumption. If we focus on conserving ecosystem services alone, will this be as effective as conserving for biodiversity (or at least the components of biodiversity we currently value)? In order to promote strategic planning for biodiversity and ecosystem services we need to understand the supply and demand for services and their spatial distribution to be able to set targets on how much needs to be conserved for sustainable and equitable supply. At present there are no accepted means of monitoring and evaluating service supply or demand, as there are for monitoring biodiversity, both nationally and at the European level.

Filling these gaps in our knowledge will enable us to effectively conserve key services, to make informed trade-offs between enhancing particular services and the consequences of such decisions for biodiversity. An understanding of how to conserve and sustainably provide services is vital and is something that it is possible to focus on given the collation of suitable data. There is a need for the collation of data for key components of ecosystem services. Integration of data across the natural and social

sciences is also necessary, with the development of methods for dealing with spatial miss-matching in the units of measurement. Improved collaboration between the potential users of such data, and those responsible for collating the various datasets would maximise the benefits from these data for assessing the sustainability of ecosystem service provision and consumption. This information will be of great importance for underpinning policy decisions at relevant scales, regarding the sustainable use of biodiversity and its associated ecosystem services.

Re: Ecosystem services as a tool to conserve biodiversity

Richard Harrington, Rothamsted Research, Harpenden, UK

I refer to the very useful contribution by Alison Holt. It may be a `chicken and egg' situation but, rather than saying that `the degradation of ecosystem services results in a loss of biodiversity' and `conserving ecosystem services would conserve biodiversity', is it not more relevant to put it the other way around, i.e. the loss of biodiversity results in the degradation of ecosystem services, and conserving biodiversity would conserve ecosystem services?

Whatever, I agree very much with the ecosystem service approach suggested and with Alison's analysis of the gaps in knowledge of the linkages between biodiversity and ecosystem services. `A service-led approach to understanding the link between services, functions and different components of biodiversity (e.g. functional groups...)' is being developed by the EU RUBICODE project and it will try to provide a framework for `setting targets on how much needs to be conserved for sustainable and equitable supply'. Rather than pre-empt future keynote contributions to this e-conference, I'll just say `watch this space'.

Auctioning plant biodiversity as a promising new instrument in the EU's agri-environmental policy: Evidence from a case study

Markus Groth, University of Lueneburg, Germany

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).

Theoretically the benefit of auctioning contracts is evident and well analysed within 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 with 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 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 more efficient use of public funds as if the administration would fix a flat-rate payment, not knowing the costs of production.

Auctioning plant biodiversity: Conception and results from a case study

In the following the conception and main results of two auctions in a case study area (the county of Northeim in Lower Saxony, Germany) will be discussed. To attend the auction, farmers had to submit an individual offer for every grassland site. The offer includes a) the choice of one quality of ecological goods (plant species richness and composition in managed grassland), which in this case were defined as ecological goods 'grassland I', 'grassland II' and 'grassland III', with class 'grassland III' being the highest quality, b) the calculation of the price per hectare and c) a description of the grassland site.

Results of two first-price sealed-bid, discriminatory price auctions point out that in fact much differentiated offers were made by the farmers in the model-region (see attachment). Even though the auctioning scheme is a comparatively simple case study, 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 first to the second auction. Therefore the research project proofs 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 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.

Main results of the case study

	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

Assessing Ecosystem Services: Spatial Frameworks

Marion Potschin and **Roy Haines-Young**, Centre for Environmental Management, School of Geography, University of Nottingham, UK

Summary: The assessment of ecosystem services depends on our ability to define what a relevant ecosystem actually is. This paper considers alternative spatial frameworks and suggests that a landscape focus is perhaps more appropriate.

One problem we face in making an assessment of the state and trends of ecosystem services is to determine what the ecosystem actually is. The problem is not so much an issue when we consider services individually, perhaps, but becomes more serious when we seek to develop a framework for a national or regional assessment. This paper presents some initial thoughts on the problem that have been prompted by a project funded by the Department of Environment, Farming and Rural Affairs, which is looking at ways in which an assessment of ecosystem goods and services might be undertaken for England. We will look at the problem of defining the 'relevant ecosystem service unit' from both the 'supply' and 'demand' side.

Supply-side approaches are perhaps more familiar to ecologists, who might immediately think of using a 'habitats focus' for any assessment. Thus we might cross-tabulate services against the habitats that we care to define, and move on to explore the processes within each habitat type that give rise to the service. In the English study, for example, we are using the Broad and Priority Habitats defined by our national Biodiversity Action Plan as a framework. The advantages of the approach is that it captures something of the multi-functional aspect of ecosystems and can be a framework through which biodiversity objectives can aligned with some of the tangible benefits they can deliver to people. The problem with the approach, however, is that services are, of course not neatly packed up by habitat units. Many of the services that we recognise (e.g. flood control) depend more on the combination of habitats in a landscape mosaic. Thus dividing up the world into habitat units might capture all the information we need to make a proper valuation of the contribution the service makes to human well being. Moreover, 'habitats' are not the units which most decision makers use in the real world and so the assessment could be viewed as 'too ecological'.

As an antidote to the 'habitat' for the characterisation of ecosystem goods and services, the English study is also exploring what how one might develop a more explicit 'service' focus. Again considering the supply side, we can think of spatial units that have relevance for individual services, such as a river catchment. Clearly the advantage of the service approach is that it draws attention to the things that matter to people. The problem with the approach is that if we define the ecosystem by reference to each service, the cross links between systems may be more difficult to detect and represent. The service approach tends to produce a sectoral view of the world, and the synergies and trade-offs that have to be worked through when solving any real world management problems are not easily represented in this framework. In any case, not all services can be packaged up in neat spatial units like catchments, and defining the units according to the nature of the service is not always easy.

Since services are ultimately used by people, then perhaps we should try to consider things from the 'demand side' of things. After all, if we are to judge whether

services levels are sufficient to sustain human well being then we need to look at where people live, what they require, and what values they attach to that area. This kind of thinking has led us to consider an essentially place-based or landscape approach, following the definition of a landscape as it is represented in the European Landscape Convention. If landscapes can be viewed as areas 'as perceived by people, whose character is the 'result of the action and interaction of natural and/or human factors', then we make some progress to representing the value of natural capital to people in the spatial units that they recognise and deal with. A landscape focus is therefore the third approach that we are testing in the English study. Its advantages are that ecosystems in this framework are explicitly coupled social-ecological systems, and we can look at the value of natural capital alongside the social and economic. The disadvantage is that such landscapes are not, of course, service units that ecologists are comfortable at dealing with.

Goods and services provided by marine biodiversity: Implications for the ecosystem approach

Nicola Beaumont and **Melanie Austen**, Plymouth Marine Laboratory, UK

Summary: The utilisation of the goods and services approach has the capacity to play a fundamental role in the Ecosystem Approach; however, current knowledge gaps prevent the full benefit of this methodology being realized.

Despite many studies identifying, defining and classifying goods and services (Costanza et al.1997, Pimentel et al. 1997, Ewel et al. 1998, Moberg and Folke 1999, de Groot et al. 2002, Millennium Ecosystem Assessment 2003), little research has been undertaken to assess if this approach is realistic or useful in management terms. In a recent publication, Beaumont et al. (2007) identified and defined the goods and services provided by marine biodiversity, adapting the over-arching classification defined by the Millennium Ecosystem Assessment (2003) (Table 1), and then proceeded to use case studies to provide an insight into the practical issues associated with the assessment of goods and services at specific locations.

Table 1. Goods and services provided by marine biodiversity

Category	Good or Service	Definition
Production services	Food provision	The extraction of marine organisms for human consumption.
	Raw materials	The extraction of marine organisms for all purposes, except human consumption.
Regulation services	Gas and climate regulation	The balance and maintenance of the chemical composition of the atmosphere and oceans by marine living organisms
	Disturbance prevention (Flood and storm protection)	The dampening of environmental disturbances by biogenic structures
	Bioremediation of Waste	Removal of pollutants through storage, burial and recycling.
Cultural services	Cultural heritage and identity	Benefit of biodiversity that is of founding significance or bears witness to multiple cultural identities of a community.
	Cognitive benefits	Cognitive development, including education and research, resulting from marine organisms.
	Leisure and recreation	The refreshment and stimulation of the human body and mind through the perusal and study of, and engagement with, living marine organisms in their natural environment.
	Feel good or warm glow (Non-use benefits)	Benefit which is derived from marine organisms without using them
Option use value	Future unknown and speculative benefits	Currently unknown potential future uses of marine biodiversity

Category	Good or Service	Definition
Over-arching support services	Resilience and resistance (Life support)	The extent to which ecosystems can absorb recurrent natural and human perturbations and continue to regenerate without slowly degrading or unexpectedly flipping to alternate states (Hughes et al. 2005)
	Biologically mediated habitat	Habitat which is provided by living marine organisms.
	Nutrient cycling	The storage, cycling and maintenance of nutrients by living marine organisms

Data availability on goods and services at the case study sites was very varied in quality and quantity. Table 2 presents an overview of the results of the case studies.

Table 2: Overview of provision of goods and services at case study areas

	Case study areas						
Good/Service	Atlantic Frontier	Banco D. João de Castro	Isles of Scilly	Belgian part of the North Sea	Flamborough Head	Gulf of Gdańsk	Lister Deep
Food provision	+	€	+	€	+	+	+
Raw materials	+	?	+	?	+	€	?
Gas and climate regulation	+	?	+	+	+	+	+
Disturbance prevention	0	0	0	0	0	+	?
Bioremediation of waste	+	?	+	+	+	+	+
Cultural heritage and identity	?	?	?	+	+	+	+
Cognitive benefits	+	+	+	+	+	+	+
Leisure and recreation	+	0	+	+	+	+	+
Feel good or warm glow	+	+	+	?	+	?	+
Future or speculative values	+	+	?	?	?	+	?
Resilience and resistance	?	+	+	?	?	?	?
Biologically mediated habitat	+	?	+	+	+	+	+
Nutrient cycling	+	+	+	+	+	+	+

Key:
+ : Present. This good or service has been recorded at the case study area and some information is available on the extent and method of provision, but it could not be quantified;

0 : Not present. The data available suggests that the good or service is not present at the site;
? : Unknown. There is no information available on the good or service;
€ : Monetary value available.

The case study sites are well studied and have more data available than most marine areas. Even so, using present knowledge quantifying all the goods and services at any given site, in a comparable way, would be impossible. This indicates the difficulties likely to arise in applying the Ecosystem Approach. If environmental, social and economic concerns are to be integrated into an Ecosystem Approach to environmental management, policy makers need to be able to quantify the provision of goods and services, on a before and after, site specific basis to get a true idea of the impact of a development or human activity. Given the short time scales associated with most environmental policy and management decisions it is unlikely that this would be possible.

As data is not available to quantify all of the goods and services, their assessment at a given site is likely to be biased towards those goods and services that are more data rich, such as food provision and recreation. There is a risk of assuming no data equates to no benefit. In the past this bias has contributed to the over exploitation, and resultant degradation, of the environment. The provision of goods are often given priority over services, as services cannot be seen or held, often do not yield immediate market value, and are generally more difficult to quantify. Services are, however, fundamental to providing humanity with a healthy and habitable planet, and are thus just as critical to human welfare as tangible goods. Utilising a goods and services framework reduces the likelihood that environmental managers will overlook certain goods and services when making a decision, and defining services alongside goods should raise their profile in environmental decision making. Adaptive management is required which utilises the available data within the context of the uncertainties, limitations and gaps in our knowledge.

Significant knowledge gaps: Services such as resilience and resistance and nutrient cycling play a fundamental role in the continued delivery of all other goods and services, but little is known about the contribution of biodiversity to these services. Time and resources should be devoted to the fundamental services rather than the already well understood goods and services. At a more holistic scale, there are still large gaps in our understanding of goods and services including, inter-dependences, inter-variability, and vulnerabilities.

Strategically important research that should be undertaken: Established frameworks of goods and services should be applied to enable comparison between studies, and too avoid re-inventing the wheel. Ideally a database of marine case studies and values should be collated, to again enable comparison between studies, and also allow benefit transfer of values which will reduce the time and resources required to undertake a study.

This text is adapted from: Beaumont et al. 2007 Identification, Definition and Quantification of Goods and Services provided by Marine Biodiversity: Implications for the Ecosystem Approach. Accepted Marine Pollution Bulletin, January 2007

Quantifying ecosystem services: research needs

Paula Harrison and **Pam Berry**, Environmental Change Institute, Oxford University Centre for the Environment, UK

Summary: Robust analytical frameworks are needed for quantifying links between species population dynamics and ecosystem service provision, assessing the ecological resilience of service-providing populations to drivers of biodiversity change, monitoring trends and success, and generating tangible values for services to inform conservation strategy.

The Millennium Ecosystem Assessment (MA) scenarios show that while ecosystem services show net improvements in at least one of the three categories of provisioning, regulating and cultural services, biodiversity loss continues at a high rate under all scenarios (MEA, 2005). Important issues regarding future research needed to understand the threats to ecosystem services from ecosystem change and biodiversity loss identified by the MA are raised by Carpenter et al. (2006). They emphasise particularly the lack of a theoretical framework to link ecological diversity with service provision and human well being. Key components of ecological diversity include species and functional diversity, and community and population dynamics (Kremen, 2005; Díaz et al., 2006). Links between species population dynamics (e.g. population density and distribution) and ecosystem service provision need investigating to fill some of the information gaps identified by Carpenter et al. (2006).

One approach to develop a research framework to address this issue introduces the concept of 'service-providing units' (SPUs) (Luck et al., 2003) (see also keynote contribution by Luck and Harrington). Here, the aim is to identify service-providing species (or functional groups) and determine quantitative links between their key population characteristics (e.g. size, distribution in time and space, and genetic diversity) and service provision. However, examples that provide this level of quantitative information are rare in the scientific literature. Work is urgently needed to provide further examples which quantify changes in population characteristics relevant for maintaining service provision across a range of scales and ecosystems.

The ecological resilience of service-providing populations to environmental and socio-economic drivers of biodiversity change also needs assessment. Carpenter et al. (2006) state that research is particularly lacking for indirect drivers such as demographic, economic, socio-political and cultural factors, which have the potential to act as better leverage points for policy. Indicators and rapid assessment methods are also essential to monitor the ecological quality, capability to deliver services and ecological resilience of ecosystems. Frameworks linking indicators to ecosystem services need to be developed with particular reference to the UN Convention on Biological Diversity (CBD) and the policy framework for implementing the CBD in Europe through the European Community Biodiversity Strategy, Biodiversity Action Plans and relevant Directives.

The translation of threats to biodiversity and the services they provide into tangible and quantifiable factors for use by policy-makers in decision-making processes is challenging, but vital for conservation. Threats to biodiversity often remain abstract, since the link between threat and action in relation to ecosystem services is missing. The economic and social costs of biodiversity loss remain unclear

and unaccounted for, as long as the services rendered by biodiversity are not explicit. Thus there is a need for the development of appropriate valuation techniques enabling costs of changes in ecosystem services, including trade-offs between services, to be calculated. Interdisciplinary studies which bring together ecological and economic information are essential to meet this challenge.

Many of these issues are being investigated in the EU Coordination Action RUBICODE (www.rubicode.net). Existing information will be reviewed and gaps in knowledge identified through analysis of current studies and workshops on related topics. A principal aim of RUBICODE is to propose a road map for future research which will be reported in February 2009.

Research on ecosystem services valuation

Clive Spash, CSIRO, Sustainable Ecosystem Division, Australia

Summary: The author calls for increased research into methods of expressing and articulating plural and multiple values and designing institutions which are able to protect and nurture them.

Ecosystems values have been placed within the goods and services context in what is an overtly market framing of the concept of value. That is the very definition of the ecosystem as supplying services means it is the service provided which we should focus upon and which is then the primary concern of our values. This has led some ecologist to take the logical step of trying to reflect the value of the ecosystems, which they held prior to the concepts arrival, in terms of a defined and bounded set of "services". Once set this task the concerned ecologist has tried to make their list as long and inclusive as possible as otherwise the "value" will be underestimated. Thus, everything from nutrient recycling to the spiritual is placed on the account (for further evidence see Spash and Vatn, 2006).

So does this market analogy help "value" ecosystems? Well the aim is to reflect a missing value in an institutional context which demands some information. If we want to calculate the value of a beauty saloon then looking at their services offered and trying to sum them up to get some total value of services provided over a specified time might make some sense. These services are traded and there is an observable exchange price. Ecosystems services like most environmental entities of concern are not traded and do not have an exchange price let alone one which is observable. So here lies a major problem which environmental economists in the neoclassical tradition have spent 40 years trying to address via their research. Their solution is to directly ask people to place an exchange price on things.

So now ecologists not only create lists of services but also place monetary numbers on these. Unfortunately most of these numbers lack any theoretical basis in terms of economic theory and are just numbers. Neoclassical economists have a (contested) welfare theory which defines the validity of the numbers they are supposed to use. Ecosystem valuation is largely predicated on transferring values with little attention to such theory. This appears of little interest because the institutional context is ripe for perpetuating the supposed validity of numbers on the sole ground of their being "practical".

"Monetary valuation is the practical approach", so the myth is stated. Now economists have a range of defences for their use of such numbers, one of which I noted is already lost here and that is theory. Still there are others. The economic pragmatists will point out that monetary numbers are but one input to a decision, that they may be imperfect but are the best we have, that people implicitly trade these things even if they don't realise it, and that, after all there are no real alternatives but weighting up the costs and benefits in monetary terms to make a choice. Well there is a large research literature which points out that every one of these points is fallacious if not just plain wrong.

Lacking space to expound here I will make a few quick points. The use of economic valuation can lead to perverse incentive and the destruction rather than preservation of a species (Damodaran, 2007). If money numbers are but one input

what are the others, and doesn't this then mean we face multi-criteria analysis? If so let's do so openly. There are many ways in which humans make decisions and the market place is only one institution for the conduct of human affairs. Research shows people hold multiple motives and refuse to make trade-offs (Spash and Hanley, 1995; Spash, 2000a; Spash, 2000b; Spash, 2006). There are a range of alternative approaches for addressing environmental values and these do not all involve exclusive monetary valuation although they do not all exclude it either (Getzner, Spash and Stagl, 2005; Stagl, 2007). Choices can certainly be made without recourse to money (Vatn and Bromley, 1994; O'Neill, 1997). There are different realms of values of which economic values are but one (Trainor, 2006; Spash, 2007). Values are noted to be commonly incommensurable although economists resist this fact (Aldred, 2002; Aldred, 2006), and this means a different basis for valuation (Martinez-Alier, Munda and O'Neill, 1998). Despite all these points and a much larger literature on them the preponderance of money numbers for ecosystem services appears seems to be ever increasing. Research is needed into methods of expressing and articulating plural and multiple values and designing institutions which are able to protect and nurture them.

Re: Research on ecosystem services valuation

Ferdinando Boero, University of Lecce, Italy

Clive Spash hits a crucial point. The values of economists are not the values of ecologists, but paradoxically ecologists are becoming economists and trying to place a price tag on everything. Oxygen production and carbon dioxyde consumption have a price (and you are "rich" if you have forests). But are these prices right? What is the price of oxygen? Since it is vital for our survival, what is the price of our lives?

I have written a book (in Italian) entitled: The ecology of beauty. It stemmed from a scientific proposal that I reviewed, which addressed the choice of places to protect with national parks. A place to protect has to function very well, so we have to measure ecosystem functions, and the better they are, the better it is to enforce protection in the well-functioning place. The ecosystem function that was chosen in the proposal was the efficiency of decomposition. My reaction to this was: if we have to elect mister or miss Universe, what do we look for? For the analysis of their urines? What we want to protect is beauty, uniqueness, and such things. At least in national parks. Then there is management for the places that have nice biogeochemistry.

We are obsessed by quantity (from the measurement of the efficiency of biogeochemical cycles to the price of goods and services) and we are losing sight of the perception of quality. And this is one of the reasons for the widespread distrust of science by the general public. In many countries national parks are proposed by the environmentalist movements, the greens, and not by ecologists. The questions of quantity are very important, but they cannot replace the appreciation of quality. I want to repeat it: quantification is essential, I am not saying that it has to be abandoned. The problem is that quality has been abandoned. Maybe we have to protect the environment not because we gain from doing so, but because it is unethical not doing so. And a beautiful world is becoming ugly. China and India are the fastest growing economies of the planet. But the balance is not taking into consideration habitat degradation and destruction. Economists think that it is possible to have infinite growth from a finite system. This is unwise, to use a kind word. If we use their arguments to protect the environment, the environment will be in trouble, and it is.

Obsession with quantity

Martin Sharman, European Commission, Brussels, Belgium

Ferdinando said, "We are obsessed by quantity (from the measurement of the efficiency of biogeochemical cycles to the price of goods and services) and we are losing sight of the perception of quality."

BBC2 is showing a short series of 3 films by Adam Curtis, called "The Trap: What Happened to Our Dream of Freedom". Curtis shows how game theory, which assumes that the players are entirely motivated by self-interest, began to creep first into economics, and later social policy. There is an especially chilling scene when James Buchanan, a highly influential economist, pours scorn on the idea of the "public interest" - nothing but the self-interest of bureaucrats, apparently - indeed, a public servant who claims to be motivated by a sense of public duty, or by satisfaction in a job well done, is either lying or a zealot.

Curtis shows that this mindset has led some governments to believe that it can best motivate people by setting targets that the individual can meet in any way he or she likes. This has led to a culture of measuring everything, and establishing indicators. Unfortunately, it turns out that targets and indicators may not do quite what you expect.

To meet targets, says Curtis, people manipulate the system, often by redefining things. "Suspicious occurrences" take the place of "crimes", so that that the crime rate drops. People compelled by targets to reply to an incoming letter within a given number of days reply with a content- (but not cost-) free "thanks for the letter", and answer it properly when they have time. Trolleys become beds if you take off the wheels, and corridors become wards if you change the hospital plans.

People also respond to indicators in unexpected ways and the indicator may provoke perverse effects. Thus when you establish league tables of school performance to encourage under-performing schools to do better, richer people vote with their feet - they move house to near a good school, leaving the under-performing schools to sink yet faster.

At a time when psychologists have discovered that only psychopaths and economists behave according to game theory, and economists are starting to wonder whether humans are as rational as their theories demand, should we not be cautious in our belief in biodiversity values, numbers, and indicators? Science is all about measurement and prediction. But are we not treading a dangerous path when we behave as though the living world were largely or entirely reducible to rational and deterministic measurements? How can we find our way to a holistic and integrated science that gives adequate space for emotion, ethics, trust and the concept of stewardship?

But if everthing really is SMART, surely somebody can create a beauty index for Ferdinando?

Re: Obsession with quantity

Frank Wätzold, Helmholtz Centre for Environmental Research – UFZ, Leipzig, Germany

I agree with you, Martin, on your sceptisism about measurement and in particular on your point that we are 'treading a dangerous path when we behave as though the living world were largely or entirely reducible to rational and deterministic measurements'.

However, Martin, as an economist I feel a bit uneasy about your references to economics and economists and I would like to clarify some points.

First economists greatly differ in their world view and quoting one economist and writing as if he is the one and only representative of a discipline does not provide an accurate picture. Working in a public administration myself I am also skeptical about James Buchanan's view of people like you and me as self-interested bureaucrats. But then, it may reconcile you a bit with economists that the famous economist Robert Musgrave in his debates with Buchanan always said (refering to people like you and me) 'I prefer to call them civil servants' (obviously having the same problems with Buchanan's view than we have).

Second, it is very easy to misuse and misinterpret some concepts economists apply. I am also skeptical about game theory and in particular the extent it has been applied to analyse each and everything. However, one basic message as contained in the famous prisoner's dilemma is that welfare is enhanced if people act in co-ordination rather than only following their own narrowly defined interest. Related to that there are a couple of interesting and useful classroom games where you can teach students that when everybody follows their own interest the environment quickly degrades.

I have worked for the last couple of years together with ecologists on improving conservation policies and overall I have seen among researchers from both discipline a growing understanding of the possible contribution that each discipline can make to conserve biodiversity. I think it is worthwhile preserving and enhancing this for the benefit of better conservation. For this purpose, more capacity building may be necessary where economists learn more about ecology and ecologists more about economics.

Perfect Match: Right Economist and Right Ecologist

Clive Spash, CSIRO, Sustainable Ecosystem Division, Australia

Frank is right to point out there is a great variety amongst economists out there and also to the mixed results from game theory.

Gintis (2000) makes the point that experimental results more generally disprove the economic characterisation of humans as being used by some in this conference (see Perelet and also Zander). Cooperation is more normal for humans and apparently homo economics behaviour more typical of other animals.

So what of the getting good economists and ecologists together. Well some of us have been trying for almost twenty years now. That was a driving force behind Ecological Economics after all. The problem is there are as many camps of ecologist/biologist as there are of economist. The unpleasant neo-Darwinist theories of socio-biology have been pure political drama with the Chicago school of economists making the most of the science for their own political ends (see Gowdy, 1987). These are people with closed minds who already have their answer to life and just want everyone else to confirm and conform. They can be found amongst both economists and ecologists.

The more progressive element is not amongst mainstream economists and for good reasons. Economics has become increasingly abstract. Its core journals engage in chasing mathematical loops for no end but playing a game of academic nicety and internal self justification. Undergraduate numbers have declined because, rather than teaching political economy with open debate, everything is now a model with an answer. I tried teaching macroeconomics by making my students see all the problems with the various theories, an old Scottish tradition called learning. They were failing their exams, set by someone else, because there was only one answer and you are not allowed to question it. A Scottish University which had along with all others rejected the enlightenment. Economics is then heading towards the Dark Ages.

Good economists can now be found in business schools and geography departments, or doing psychology or applied philosophy, or studying politics and history. Unfortunately they seem less likely to be produced by economics departments.

I find mainstream resource and environmental economists are by and large, basically, only concerned with applying the answer they already have preconceived. They have a set model and human behaviour and humans had better dammed well fit it. They go to great extremes to design things so people do fit. This is called creating incentive mechanisms.

Much of what I've read in the last few days in this conference is sadly heading in the same direction. Narrowly conceived political economy with even narrower perceptions of human motives and behaviour. A desire for the answer regardless of what lies out there in the socio-economic reality.

So I'm sorry but there is good reason for non-economists to chide the economics profession; all the 'good' economists I know do so themselves. As an economists I see the subject in a crisis and one which has been on-going for decades now. Mainstream economics, which defines the field, excommunicates people who try to speak openly or who question the orthodoxy, or who become too interdisciplinary. Strangely then Kahnemann, a psychologist, got half the Nobel prize in economics, having spent his life criticising the mainstream. Perhaps the committee was try to send its own message.

In closing, I would also suggest some ecologists deserve just as much chiding for their naive acceptance and adoption of mainstream economics, monetary values and simple market mechanisms. The leaders in this direction, which I have met, are just as arrogant and self righteous as the mainstream economists. Both seem to be set on proving homo economicus is alive and well using their own behaviour as the primary evidence.

Quantifying ecosystem services: the SPU concept

Gary Luck, Institute for Land, Water and Society, Charles Sturt University, Australia; and **Richard Harrington**, Department of Plant and Invertebrate Ecology, Rothamsted Research, UK

Summary: The service-providing unit (SPU) concept is a framework for quantifying the biotic components of ecosystems that supply services to humanity, and the information gained through this approach is crucial to land management and policy development designed to ensure the ongoing supply of ecosystem services.

The loss of species population diversity (the size, number, distribution and genetic composition of populations) is of growing concern to ecologists (Hughes et al. 1997; Ceballos and Ehrlich, 2002; Luck et al., 2003). The impact of population change on human wellbeing is, arguably, most readily identified in the implications it has for the provision of ecosystem services. The service-providing unit (SPU) concept was introduced as an approach to link explicitly species populations with the services they provide to humans (Luck et al., 2003). These services include pollination, pest control, nutrient cycling, recreation and the production of goods (e.g. food and fibre) among many others (Daily, 1997). The provision and utilisation of such services is often most easily recognised at the local level – hence the focus on localised assemblages of individuals and species.

SPUs provide, or might provide in the future, an ecosystem service at some temporal or spatial scale. Service provision is context dependent and can vary with environmental, cultural or socio-economic change. The crucial argument presented by the SPU concept is that changes to key population characteristics have implications for service provision and these changes need to be quantified to understand fully these implications. For example, a density of 33 mallard ha-1 over a 180-day period was sufficient to improve the decomposition of rice straw (compared to treatments with no mallard) (Bird et al.,2000). A certain population density is crucial for service provision, although there was no indication of the consequences of lower densities (other than zero). Nitrogen and carbon cycling were substantially improved in a disturbed freshwater system that supported ~ 8000 Chinook salmon over a 5 month period compared to one that supported only ~ 100 salmon (Merz and Moyle, 2006). Population size is crucial, and the further the salmon swam up river the further inland marine-derived sources of nitrogen were dispersed.

The SPU concept should not be misinterpreted as emphasising any one species above others that may provide the same service, or an approach that constrains the focus to a single service when it may be more appropriate to examine ‘bundles’ of services. Moreover, the concept is easily extendable to include other levels of organisation (e.g. functional groups). For example, watermelon crops in California are pollinated by several native bee species. Maintaining the diversity of the native bee community is essential because of temporal fluctuations in the population of any one species and variation in pollination effectiveness among species (Kremen et al., 2002). The SPU in this example is an appropriate diversity of species and abundance of individuals to ensure provision of the service across time and space.

Quantifying the biotic components of ecosystems that contribute to service provision is crucial to guiding land management and policy development. However,

such examples are extremely rare in the scientific literature. Researchers may identify ecosystem service providers, but not quantify the units required for service provision, or research on ecosystem function may provide detailed quantification of functional units, but not elaborate on their potential for the provision of ecosystem services. The value of the SPU concept in rationalising biodiversity conservation in dynamic ecosystems is being explored in an EU Coordination Action, RUBICODE (www.rubicode.net). Ecological and economic information will be brought together in case studies covering the main ecosystem service categories of the MEA across multiple scales. The case studies will explore relationships between SPUs and socio-economic and environmental drivers of biodiversity change, and evaluate management strategies for service provision. We are very keen to hear of any examples where biodiversity has been linked quantitatively with service provision in any ecosystem.

Re: Quantifying ecosystem services: the SPU concept

Elena Bukvareva, Severtsov Institute of Ecology and Evolution Russian Academy of Sciences. Moscow, Russia

In my opinion the concept of service-providing unit is an extremely useful analytical instrument, especially in research and valuation of boreal ecosystems. As I mentioned in my message to the session 2, in boreal ecosystems a significant part of regulating functions passes from species diversity to intraspecific diversity. In relatively unstable and severe environmental conditions optimum values of species and intraspecific diversity shift in opposite directions: species diversity decreases but intraspecific diversity increases. In such a way biosystems adapt to environment. In boreal ecosystems (as well in other relatively unstable ecosystems) intraspecific diversity plays a key part in ecosystem regulation and ecosystem functions. Thus the SPU concept is an important tool for the analysis of such ecosystems. In boreal biomes some species include a lot of ecological and geographical forms. Each of them has a specific ecosystem function. I think that sometimes the loss of some intraspecific form may lead the same serious degradation of ecosystem function as the loss of species.

The SPU concept is useful not only in biological research but also in practical nature conservation. It is applicable to the elaboration of conservation programs of individual species. For example, I recently took part in working on the Strategy of conservation of Kamchatka mykiss (*Parasalmo mykiss*). The aim of this Strategy is to conserve the great diversity of intraspecific forms of mykiss which provides stability of this species. I hope the SPU concept will help us to produce extra arguments for protection of the full spectrum of mykiss forms in Kamchatka.

The necessary kind of knowledge

Ute Zander, Learning processes for sustainable development, Wuppertal, Germany

To me there is a question in the background that arose in some of the discussions: Do we know enough to inform decision-making? I would like to put it in a different way: Can we provide the right kind of knowledge to inform decision-making? and: Do we elaborate this knowledge in a way that has an impact on decision-making? On the second question some participants of this e-conference have already made relevant contributions mentioning e.g. participatory development of solutions (see esp.: Felix Rauschmayer and Thomas Koetz in Session III). On the first I would like to give some ideas.

When it comes to decisions, it is not so important to the decision-maker whether the information is right (true, robust, exact, of high probability etc.) but whether it is relevant to his or her own situation and interests. In other words: The relevance of information is not an objective matter of scientific results but is relative and dependent on the person receiving it. Science mainly still concentrates on information, that is relevant from a scientific point of view. This is natural because of the incentives of the science system. To influence decision-making - if research is aiming at that - the problem must be seen from the view and in the context of different decision-makers and their situation. In some way, scientists are the wrong target group to ask the question, where further research is needed.

One example: Politicians need arguments for certain decisions. One of the most powerful arguments in that context is money. Learning from climate change the Environmental Ministers of the G8 countries decided to fund a study on the economic costs of biodiversity loss. They expect a similar impact on the CBD implementation process and on the general discussion of the issue in the media as from its model: the Stern Report.

Focussing on cost is - hopefully - not the only way to influence decision-making although it is an important one and can often be used as the icebreaker for a certain issue. Building on this as a first step other kinds of information can be elaborated. Ecosystems and their services are a good framework to do this. Especially when they are combined with the Ecosystem Approach of the CBD in an even more implementation oriented way than in the MA.

As someone who works at the interface between knowledge and action I would suggest more “research” and activity on evaluating and integrating existing knowledge (scientific and other) from the view of different target groups, which are crucial to halting the loss of biodiversity. This also means focussing more on option assessment, development of synergetic solutions, ways of target setting and strategy development as well as possibilities of implementation.

Re: The necessary kind of knowledge

Allan Watt, Centre for Ecology and Hydrology, Banchory, UK

Ute Zander makes an important point in stating that scientists are the wrong people to identify where research is needed. I agree insofar as the development of research priorities should be done though dialogue involving policy makers and other stakeholders. But to state that scientists are the wrong people is, to quote Clive Spash

out of context, “fallacious if not just plain wrong”. We would not have the Millennium Ecosystem Assessment and much, much more if it were not for scientists.

Ute Zander identifies the need for focussing on cost. No doubt this focus is important, as the Stern Report shows. But if anyone imagines that the same can be done easily for biodiversity loss, they should read Clive Spash’s contribution to this e-conference.

Comment on Ute Zander’s contribution

Clive Spash, CSIRO, Sustainable Ecosystem Division, Australia

Ute Zander argues a pragmatist case for monetary valuation. In doing so she creates a straw man characterisation of the political process and misinterprets the history of inaction on climate change.

According to Ute, there is such a thing as a “decision-maker”. This person she tells us cares nothing for truth or accuracy but it totally self-interested. Having made this characterisation she goes on to tell us that money is the key thing in politics.

Well sorry but if that’s your political system then sounds like you need some serious democratic reform. Under the above system he who pays the “decision-maker” most gets what they want. Forget producing bogus numbers to feed into a corrupt process.

Lets assume the world is a little different and there is a political process which evaluates information and takes decisions on the basis of some of the standards held in democratic constitutions and protected by legal systems, there might even be some people with a few morals. Why would you focus on the effort to convert environmental damages into monetary numbers?

Ute’s main argument seems to be that this succeeded in getting action for climate change mitigation. Well sorry Ute but there hasn’t been any action despite 20 years of cost-benefit studies on climate change. We are still facing business as usual. In fact the use of these numbers to lobby against federal gas control in the USA is well documented, and key models have been funded by fossil fuel energy interests. So not such a great example to follow. If anything it seems to head more in the direction of his caricature.

The other argument is that you need to translated science into these terms to get your foot in the door and you real message can come later. Forgive my ignorance but wasn’t there something called the millennium assessment? I thought the door was already open? Again reflect on climate change. In the late 1980s there was political will to take action and some serious cuts in emissions were on the table. Monetary assessment did not put the issue on the agenda and we have gone backwards since then in terms of achieving cuts.

Re: The necessary kind of knowledge

Renat Perelet, Institute for System Analysis, Russian Academy of Sciences, Russia

The subject can be viewed from different angles. Firstly, natural capital is becoming depleted because there is no real market (and market value) for renewable natural capital (oil, gas, some metals luckily have their price on the world market). Among

the three kinds of capital - produced (all human made things around us that are easily marketed that, according to the World Bank, constitute not more than 15-18% of the overall national/global wealth), social/human capital (that is growing in value and price), and natural capital, the latter has the lowest share in the world market and trade. For example, pharmaceutical and perfume-making TNCs reap huge profits paying peanuts to get organic raw materials from developing countries that later get medicines at high prices. Even in Europe, medical and aromatic plants are cheap. That is why they are becoming scarce.

Secondly, showing a realistic high value of ecosystem goods and services in monetary terms is what is lacking and necessary. Hence, environmental valuation as well as economic and environmental accounting systems are needed (e.g. ISEEA suggested by UNEP in 1993 and updated in 2000). In addition, attempts have been made to stress that GDP is an indicator of economic (good and bad) activity dynamics but not of human welfare that is basically dependent on ecosystem goods and services. When the national nature reserve manager goes to the financial officer he/she should talk to him in the same language of money (as it is the only common denominator governments understand) and persuade the minister of finance to allocate the money for the nature reserve with arguments about the high monetary value of (rare) species, even if s/he thinks to him/herself that they also have a high scientific or scenic or intrinsic value. If we changed the monetary system to, say, biomass indicators (there are proponents of such a change), then things would be different. So, we should work within the system we have. Land plots should be priced with due account of the biodiversity value they carry so that they can compete with the use of land for other developments.

Thirdly, UNEP, CBD, UN ECE, IUCN, WWF and other organisations have recently decided to study the subject of international payments for ecosystems services building on the experiences available up to date.

Fourthly, I suggested at several scientific conferences that a protocol on biodiversity similar to the Kyoto protocol could be a useful way to conserve and use ecosystem services in a sustainable way.

Incidentally, I am at variance with the MA report by arguing that one should separate ecosystem goods (that are movable and may participate in the world trade) from ecosystem services (that are usually immovable and can hardly be separated from the place ecosystems are located)

Comment on Renat Perelet's contribution

Clive Spash, CSIRO, Sustainable Ecosystem Division, Australia

Renat Perelet argues four points:
1. A lack of markets is the problem, not anything else.
2. Talking high prices is best.
3. People are doing this.
4. Kyoto is a good example to follow.

On 1: The logic is then that we must have markets for everything. Markets for babies or they will not be valued. Markets for grandmothers or they may not be supplied in large enough quantities. Markets in oxygen perhaps would be best of all as that really is lacking a decent price and yet isn't it rather important?

On 2: The price must be a "realistic high value". What if it is a realistic low value? What if people just don't care about ecosystems or their goodies? If you appeal to market preferences for your value then you must be prepared that nobody wants what you are trying to sell. Mainstream economics uses a preference utilitarian model and that means preferences are king and if people don't care you have no value, and that's a reality. Or may be they just want more toys, 4 wheel drives, clothes etc.

On 2: GDP is a measure of material and energy throughput, nothing more.

On 2: Why would you want to conceal your true values so you can talk to a finance Minster about money? Hopefully you Minister has a family even and might have values besides financial ones? Try getting a reserve established by a political process. Presumably your Minister was elected so has some concerns about what the public think, believe and value. If people hold other values they will need to express them in other ways.

On 3: Paying to support something does not equate to placing a value on it. A charitable donation to save starving children does not mean this is that value of their lives. Such support payments are important wealth transfers they do not equate to the value of ecosystems.

On 4: As much as I would like to see Kyoto do something and still hold its better than nothing, it is not a success. The highest per capita (USA and Australia) and absolute (USA) emitters have not signed. The targets were to small to achieve anything in terms of preventing climate change in any case. This is not a great example top follow.

Oh yes, and by the way, why do we have to accept institutions and their values? In the last few decades of the 20th century just a few major European institutions changed and popular protest played its role. If institutions demand meaningless numbers rather than wanting to know what values people hold then I would suggest they are in need of reform and some walls may need to be taken down.

Comment on Renat Perelet's contribution

Renat Perelet, Institute for System Analysis, Russian Academy of Sciences, Russia

My points were and are as follows:

1. A lack of markets is a problem since social values do not seem enough and do not often work. It is a big problem since, as I mentioned in my input, for many valuable ecosystem (ES) goods and services there are no markets at all or for those with markets these grossly undervalue ES goods and services. Pharmaceutical TNS is a just one vivid example. Social values are used by economists in the willingness-to-pay (preferences) valuation. Here is the room for voluntary contributions and donations. One should not forget that nature (as humans) has intrinsic value, however life insurance expressed in numerical terms does exist. Just note the difference between the value and the price. But ES goods and services are certainly at a disadvantage in the current monetary world, markets and budgets.

2/3. Talking high values is best (not necessarily or always high prices but high prices check wanton use). Government can (should) impose on a private land owner special regulations on private property if the land has a rare species on it since it is a national heritage (common property). And it is done. The land owner becomes responsible for that plant or animal. This automatically raises the price of his plot and the value of the species. Talking economic value of ES goods and services does not

exclude in any way other arguments of social (amenity) values to conserve biodiversity. Incidentally, natural scientists talk about conserving ecosystem functions while economists about goods and services. It depends who you are talking to. Three final goals (conservation, sustainable use, equity) are put in the CBD.

4. The Kyoto protocol is just an example because it is well known and my suggestion is to make use of a similar market based approach to conservation and sustainable use of ES goods and services ... in addition (!) to other approaches. Incidentally, using this approach between EU and developing countries one can swap, say, European technologies/ education advances for ES goods and services or access to them. External debt of developing nations can also be written off using the debt-for-nature swaps.

In sum, I do not disagree with Clive Spash. Rather, my suggestions are complementary to his.

Research needs for practical implementation of RUBICODE concepts

Rob Tinch, Environmental Futures Ltd and **Sybille van den Hove**, Median SCP and Institute of Environmental Science and Technology (ICTA), Autonomous University of Barcelona, Spain

Summary: RUBICODE aims to establish how the SPU concept may be used to link changes in biodiversity to changes in services, and to demonstrate how future research using the concept could provide practical tools for improved management of biodiversity-ecosystem service links.

The approach of the RUBICODE project is covered in the e-conference contributions by Luck and Harrington (Quantifying ecosystem services: the SPU concept) and by Harrison and Berry (Quantifying ecosystem services: research needs). This contribution focuses on the potential practical value of the project and its concepts.

The value of RUBICODE concepts as motivations for action and as components of practical tools are being addressed in the context "linking threat to action". The need is to show how particular threats to ecosystems, or biodiversity, or ecosystem services can be demonstrated, measured, evaluated and communicated to stakeholders in such a way that they are able to act upon the information in an appropriate, timely and useful fashion. Key stakeholders include land-managers and resource users, who make day-to-day decisions about biodiversity and ecosystem service management, and also policy makers at EU and national level who shape conservation and service-use frameworks and strategies.

The Service Providing Unit (SPU) concept aims to identify units for management which may or may not overlap with existing classifications (population, species, community …) in any given case. The aim is to demonstrate the value of a common language and framework at various levels and perspectives. The SPU concept needs to demonstrate what actors get out of biodiversity, including ecosystem services and functions, as well as direct use of habitats and species, and it must give a framework that decision makers, land managers and users can understand and use to increase the flow of benefits and ensure sustainability of nature's services.

For example, in managing a SPU to increase benefits and/or ensure sustainability, a decision maker needs to know:

- What is the service and why is it important?
- Which species, functional groups or traits are needed?
- How many of them?
- Where and when?
- What threats are faced?
- What indicators show "health" of the SPU / service?
- What actions are possible, under what conditions?

With a focus on improving management strategies, we need to show how aspects of SPUs and ecosystem services can be quantified. Ecosystem services may involve economic, social, environmental and cultural dimensions. Trading-off or balancing different values is an essential part of decision-making, and consideration also needs to be given to scoring, weighting and valuing options for SPUs and services.

The full potential of this Coordination Action can only be realised if a wide range of stakeholders – including scientists, policy makers, land managers, resource users, NGOs – participates in the process of developing the concepts and tools. The integration of stakeholders within research is therefore a key theme across the project. A database of stakeholders is being maintained. Details about opportunities for involvement can be found on www.rubicode.net

The overarching goal is to show how the SPU concept may be used to link changes in biodiversity to changes in services, and to provide improved tools for managing this. As a Coordination Action, RUBICODE has primary objectives of clarifying and testing the key concepts, and defining a roadmap for future research. In particular, quantification of links will be beyond the scope of RUBICODE, but should be a component of a future research projects.

Coming back to research questions

Carsten Neßhöver, Helmholtz Centre for Environmental Research – UFZ, Leipzig, Germany

Although I very much enjoy the very general discussions on the ecologist-economist worldview topic (and the "Biodiversity-Stern" discussion in session I), I have the feeling that it leads away from the topics we are addressing in the e-conference, namely: What are the main research topics that need to be addressed in future biodiversity research, regarding (in this session) its relating to ecosystem services. I think it has become clear that "economic evaluation" is not everything, and that if we have to do it- how can it be done in an ecologically sound context, e.g.

- We have had several contributions outlining the SPU-context (which is used in the RUBICODE project) - what are your opinions, questions about it, is it feasible in a broader context?
- Markus Groth introduced a concept of auctioning the provision of services by land users -do we need more such approaches?
- How do we approach/ use the ecosystem services concept (e.g. to get people involved), without forgetting about intrinsic values of biodiversity: Marion Potschin's and Roy Haines-Young's contribution on spatial frameworks is an interesting piece to start discussion on that: which spatial units should we use - how do we link ecosystem services concepts with landscape ecology concepts (or do we know enough from the work in the latter for the former)?
- What would be needed in a European assessment on multiple scales - do we need just two scales (European, local), or in addition national ones?
- Nicola Beaumont and Melanie Austen raised the topic, that we understand quite well the role of biodiversity in provisioning goods and services, but far less for supporting/basic services such as resilience and resistance- what is needed here and can it be linked to concrete applications?

I think these points might help us to bring the discussions of today and tomorrow more back to the ground and to concrete research recommendations.

Re: Coming back to research questions

Clive Spash, CSIRO, Sustainable Ecosystem Division, Australia

Carsten raises some interesting questions which would take a long time to address in any depth. There is also a prior question to this, which is to what end are concepts being applied?

For example, if your only concern is efficiency then may be a market approach is suitable, but this is something to be tested on grounds of efficiency. However we have many other goals in society: justice, equity, protecting the innocent, avoiding deliberate harm, respecting human rights, avoiding cruelty to animals.

The goals, the ends, have not been articulated. Indeed they may be inseparable from the values people hold. There is then a chicken and egg problem. Different people from different perspectives, jobs, cultures and disciplines give different answers.

What is clear is that market mechanisms serve only very limited ends and these exclude some of those commonly articulated when concern is expressed about

biodiversity. The great effort by some to apply market instruments, auctions, tradable permits and so on, is ideologically driven not based upon what is best to protect plural social values or increase human well being. Modern economics makes no pretence to do anything but be concerned about efficient resource allocation ignoring all other considerations. Many doubt it can even do that given an unrealistic theory of the firm and human psychology.

What is clear is that corporations do not reflect the wider values in society they are organisations with very specific ends and these diverge strongly from the ends of other organisations and social groups.

What is clear is that people hold multiple motives to action and express plural often conflicting values. If you want to address behavioural change you must understand what motivates people in a given context.

What is clear is that science is an expression of one set of world understandings and cannot answer social questions. How science, and its application through technology, interfaces with society is a key concern of modernity. As is slowly being recognised by natural scientists they are engaged in a social structure and their role is far from the mythical process of delivering objective facts to an ignorant audience who will be informed, add some values and come to a decision.

One problem I see in the ecosystem services framing is that it has (like the concept of capital) come from economics and now is being adopted by natural scientists who, from what I can judge in the conference, are now concerned to sell the concept to politicians and the public. Why? What does this achieve? If you want to communicate with the wider public why start with a concept which tries to encapsulate a physical (let alone meta-physical) world in a social construct which is value laden and market based? How about asking people how they relate to biodiversity as the first step? How about studying the problems in current policy e.g., as reported by Susanne Stoll-Kleemann in this conference, or elsewhere by (Damodaran, 2007)? We might at least then identify the dysfunctional relationships and pinpoint failings. General measures of general concepts may get some general motivation, but even this might be achieved more effectively by other means.

Re: Coming back to research questions

Renat Perelet, Institute for System Analysis, Russian Academy of Sciences, Russia

As regards the call to narrow down the discussion on future research issues, a spectrum of proposals seem to have emerged that are really worth considering. The issue of ecosystem services (ES) valuation seems to get diversified. First, the valuation of the current ES services. It usually produces a high and impressive figure (like R. Costanza's value of the Earth) difficult to deal with if one designs a policy for conservation and sustainable use of biodiversity. Secondly, there is an approach to value damage inflicted to ecosystems to demonstrate a high value of costs needed to restore the damaged ecosystem back to some (which?) initial state that was proposed by E. Bukvareva. Thirdly, she also suggested introducing a service-providing unit. Fourthly, I would suggest exploring the value of the remaining resilience capacity of an ecosystem and work with increments, rather than the overall value of ecosystems. This may reveal whether and how much investments are needed to improve the situation with an ecosystem. I agree with Clive Spash that market approaches have a lot of limitations since they mainly aim at getting the right (?) resource allocation. But

they are necessary as just ONE way of changing the present distorted market (or no market, often concealed eco-piracy) by raising or demonstrating high values of ES remaining or damaged services through auctioning, permit trading, ES insuring. The work 'Trouble in the Air' shows an vivid example of perverse results obtained using CDM due to institutional deficiencies.

Prof. Sergio R. Peca-Neira suggestion to use ES services permit trading in Europe could also be explored against the background of the failure to apply this approach in Europe to sort out the transboundary pollution problem. Numerous tables were made showing numerical amounts of sulfur emitted by individual countries and received by other countries so that those blamed for emissions should compensate damage to those countries that were affected but nothing happened. The market mechanism did not work and was not applied. The problem was resolved by concerted efforts of European countries to bring down sulfur emissions and these efforts did work. My earlier proposal to make a Kyoto-like protocol on biodiversity was aimed at global permit trading in ES services where it could possibly work better than on the European continent in view of the above past experience with transboundary air pollution. Finally, a Baltic sea valuation study (Jan Marcin Weslavski) could also be explored to apply elsewhere.

Biodiversity mapping

Ferdinando Boero, University of Lecce, Italy

Carsten is asking us to abandon philosophical issues for now and go back to concrete things. Before doing so however, I want to re-assure Clive about the value of economists. What he is describing for economics is taking place also in ecology. Journals produce lots of models with sophisticated mathematics and careful prediction of the future. And people forget about natural history, and of relevant variables. This is the key word: relevance. I do not care about the fancy mathematics of the model, if the relevant variables are not considered, then it is just a nice exercise. I heard a modeller saying that his model was perfect, it was the Atlantic Ocean that was wrong!

Now let's go back to things to do. If you ask me a thing I would like to see done in Europe, here is my answer:

- A list of marine habitat types that goes from Norway to the Mediterranean, with the seasonal characteristics, their description, and their mapping. So to find places of discontinuity in habitat distribution, define biogeographic boundaries and so on. This has been done with Corine projects, but there is nothing like that in the sea. Bits and pieces, but not a comprehensive effort at mapping our sea bottoms.

I have said it already: science is based on describing patterns and then in understanding the processes that generated them. The first thing we need is the pattern of distribution of biodiversity at a habitat type throughout Europe. Assembling all the information that is dispersed in the literature. And performing new observations (things change....). The Habitat Directive of the EU contains a ridiculous number of marine habitat types. It heeds revision.

Once we have identified the patterns, we can start to play about their generation. But the first thing is this: a snapshot of biodiversity distribution and state at a habitat level. Then we have to pass to species. Every habitat should lead to a master list, with all the species that were recorded from it in the past. The master list is what we can expect to find if a given habitat type occurs. At some places the same

habitat type will be more diverse and at other places it will be less diverse. From this, we can go in many directions, but we still lack the basic information. Ecologists are more keen in producing nice models from their computers, or from their mesocosms, than to go out there and simply look. Maybe it is the same attitude that affects economists. Again, I do not want to be misunderstood: models are very good, forecasts are very necessary. Let's do them. But let's not abandon looking at the world. If we do so, we lose contact with reality. And I have the impression that modellers and future tellers are going on by themselves. Thinking to be self sufficient to produce science. And this is one of the reasons for the disappearance of taxonomy. Too much work. Who do you think can produce the master lists of species for habitat types?

Re: Biodiversity mapping

Jan Jansen, Radboud University Nijmegen, the Netherlands

I fully agree with you Ferdinando, both on mapping marine habitats and the importance of fieldwork. A few years ago I stressed the importance of fieldwork during another EPBRS e-conference, see:
www.edinburgh.ceh.ac.uk/biota/Archive_livelihoods/5563.htm

The big problem is the utilitarian attitude. I always hear say that field-workers are too expensive, and that modelling and remote sensing are better. I am not against remote sensing as long as you know what you do. But I stress the importance of experienced field-workers. There are too few of them. The argument that they are too expensive is strange since they usually earn a lot less than scientific desk- and laboratory-workers. For many it is therefore unattractive to become a field-worker. In the Netherlands they say that "wie schrijft die blijft" ("who writes stays"). Research now is often "quick and dirty". Our managers like the so-called "quick-scan". This is not in favour of the field worker.

A good field worker can collect lots of very useful data, at least if the sampling method is reliable. So this is a simple message: researchers should focus more on field work.

Interdisciplinarity and the Millennium Ecosystem Assessment: research challenges in Europe

Paul Armsworth, Department of Animal and Plant Sciences, University of Sheffield, UK

Summary: The author sets out research requirements for meeting the requirements of the MEA, both at the individual and institutional level.

During the writing of the Millennium Ecosystem Assessment, a suite of topics were identified in which the existing research base was not adequate to support the types of management decisions needed to ensure sustainable flows of ecosystem services (Carpenter et al., 2006). While some of these research questions were disciplinary in nature, many more arose at the stage of mapping ecosystem services through to different constituents of well being (see Fig A in MEA, 2005). Indeed, the interface between ecosystem services and well being constituents is where the conceptual contribution of ecosystem service science is most innovative. For some research questions, the necessary interdisciplinary interactions, while still young have some precedent to draw upon (the meeting of ecology and economics) (Armsworth and Roughgarden, 2001), whereas other interactions are hardly developed at all (ecology and psychology or sociology).

There are interesting examples emerging where the scientific community has begun to rise to the research challenges posed the MEA. For example, various efforts (albeit it not in Europe) have recently been published that aim to map the economic value of a suite of ecosystem services across whole landscapes (Naidoo and Ricketts, 2006; Troy and Wilson, 2006). These enterprising early efforts show much promise. But there are important shortcomings that have yet to be addressed. Typically, efforts at mapping ecosystem service values are premised on generalising from available valuation estimates that are very patchy in their coverage. The appropriateness of the assumptions about benefits transfer this requires remains to be tested. Also the available efforts have a map-based vision of ecosystem services and ignore all but the simplest spatial interactions in social and ecological systems. One of the most important outstanding questions of course concerns whether such shortcomings matter, and we need to assess the degree of accuracy needed from ecosystem service studies in order for them to support more informed land use decisions.

Perhaps the most important challenge for scientists is in learning to ask questions differently. We need to start from the end-point of recognizing what decisions or policies our science is intended to inform, what instruments are available to influence those decisions, and then work back from there through ecosystem service pathways to underlying ecological mechanisms. Shooting forwards from very small-scale ecological observations will not get us to the end-points at which we ultimately need to arrive.

At least in the UK, the institutional structures within which the scientific community operates do not lend themselves to meeting the scientific challenges of the MEA. Yet, there are important models of success on which we can build (such as the RELU programme), albeit small in scale relative to the scale of disciplinary science. Major institutional changes will be needed in the research community if we are to

build the scientific capacity required to meet the challenges of the MEA. For example, this will require:
- New career opportunities and greater career continuity for young interdisciplinary scientists (the new ESRC fellowships are a very promising development in this regard);
- New funding opportunities: The most sustainable funding avenue would be to have applied interdisciplinary research projects valued in core "blue-sky" funding rounds, rather than primarily being promoted through special programmes which often have a strong restrictions on their remit and focus.
- New publication outlets - Is there sufficient demand to support a European rival to PNAS for example?

Value transfer problems

Clive Spash, CSIRO, Sustainable Ecosystem Division, Australia

I would just like to point out that value transfer is not something which "remains to be tested". There have been numerous tests and there are serious problems with the approach. See Spash and Vatn (2006)

Large Scale Projects and the MA

Josef Settele, Helmholtz Centre for Environmental Research – UFZ, Halle, Germany

In a visionary phase of political decision-making, the European Commission (EC) initiated new instruments of research funding within its 6th Framework Programme (FP 6), including the Integrated Projects (IPs), large-scale interdisciplinary programs. The first ones started in early 2004 with several tens of partner organizations and funding beyond 10 million Euro. In FP 7, launched on 22 December 2006, this instrument was scaled down and -at least for the first funding cycle -nearly abandoned. Why has this change been made? Will most of these IPs, which have at least two more years to go, be failures? Since February 2004, we have coordinated the IP ALARM (Settele et al. 2005), which is made up of 67 partner organizations and 250 scientists from 35 countries and receives EC funding of nearly 13 million Euro. ALARM focuses on some of the main drivers of biodiversity change (climate and land use change, environmental chemicals, invasive species, and loss of pollinators (Biesmeijer et al. 2006)) and combines ecological, environmental, and economic research. The consortium includes many leading scientists, who increasingly appreciate the opportunities offered through a project of such size and scope, e.g., by forming new teams conducting inter- and transdisciplinary research.

This is exactly what is urgently needed in science, as expressed by Carpenter et al. (2006): “Meeting the research needs described will require new coalitions among disciplines that traditionally have been isolated.… The [Millennium Ecosystem Assessment] has provided a road map; now, we need to start the journey.” We think that large integrated projects have the clear potential to fulfil these requirements. By initiating the IP instrument, the European Commission created considerable support to get the journey started. Do they now intend to stop halfway?
Source: Settele et al. 2007. (text slightly modified):

Ecologists and Economists

Mac Callaway, UNEP Risoe Centre on Energy, Climate and Sustainable Development, Roskilde, Denmark

The main things to do are: 1) to get the physical impacts right and 2) for natural and physical scientists to communicate with economists about what information is needed, exactly, to conduct any economic valuation work.

This communication needs to start early on in the planning stages of a research project. The idea that economic valuation is an "add on" that happens at the end of the project is not a good one.

I have worked on integrated assessments in which these groups communicated poorly (and argued a lot) and the result was that the information that was produced about ecosystem impacts was not very useful for high quality economic valuation work.

Ecologists and Economists need to be interdisciplinary

Clive Spash, CSIRO, Sustainable Ecosystem Division, Australia

Economists don't just do valuation and ecologists don't just supply objective information in the right form. This linear approach to interaction fails to take into account (i) the necessity of process and interaction being iterative (ii) the breadth of the fields of knowledge and how learning takes place (iii) the challenges of interaction resulting in new ways of thinking.

The linear approach is not interdisciplinary but rather is multi-disciplinary in allowing limited ranges of communication. As Mac Callaway describes this, the economists telling the ecologist what they need, to do their thing. Interdisciplinary research must allow both parties to change the way they do things and this means, among other things, learning from 30 years of ecological economics that monistic valuation fails to address the issues we are tackling when addressing such things as biodiversity loss and human induced climate change. Economists need to be researching ways in which people can articulate their values rather than forcing people to give the right answer (i.e. a willingness to pay number) when they explicitly reject that approach.

Valuation of ecosystem services in the Baltic Sea: a case study

Jan Marcin Weslawski, Institute of Oceanology, Polish Academy of Sciences

Summary: The author presents some results from a study on the valuation of ecosystem services in the Baltic Sea and argues that such valuation exercises require more socio-economic research on the views and opinions of the people living around the Baltic Sea.

With the wave of interest and need for socioeconomic approach and environmental economy, the concept of ecosystem valuation has been developed over last few years in the marine domain. Recent review papers on the socio-economic valuation for the Baltic and biological valuation review will be available in the March issue of OCEANOLOGIA nr 49/1 (full text: www.iopan.gda.pl/oceanologia/48_1.html#A9).

The first method assesses the value of ecosystem services from the man/user point of view, with the value expressed in monetary units. The second method assesses the intrinsic value of ecosystem services and is expressed in more abstract values like integrity and resilience. Valuation methodology has been developed to assist the science-based management of natural environment as a handy tool for decision-makers. The social component of the valuation exercises is very strong, and, as such, the public opinion may modify the study results. This is especially the case in the Baltic Sea where on one hand the sea is very well studied, while on the other hand, the area has a bad reputation of being the "most polluted sea in the world", a "dying sea", a "sea of aliens" etc. These negative connotations affect economic decisions, particularly in the field of the recreation industry and spatial planning.

The use of valuation techniques and information needs a trained recipient, since the information provided can be misleadingly simplified in some categories (like poor, good, excellent) or price ranges. Two different educational traditions and scientific methodologies meet in environmental valuation. Biologists and chemists may think that socio-economic valuation provides as good and hard-fact results as their own science. Unfortunately, the social part of the story is different. In the Baltic Sea basin, there are nations with a long history of sea use (e.g. Finns) as well as communities with weak maritime traditions (e.g. Poles). Modern history and politics have formed the views and opinions of coastal inhabitants as well. What is good and desirable in the Baltic for the citizen of Stockholm, is not necessary acceptable to inhabitants of a small village on the Polish coast. Controversial issues like corrections of ecosystem, erosion, protection of fish stocks, attitudes towards sea mammals and seabirds are determining our choices and decisions. To develop the very much needed valuation of the Baltic Sea, we need to learn much more about the Baltic people – keystone species in this ecosystem.

The damage-based approach to economic valuation of biodiversity

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I am fully concordant with the view of Ute Zander and other participants of the discussion that economic valuation of ecosystem services is a key instrument for the interaction between ecologists and politicians. The main problem in my opinion consists in lack of a practically applicable method of valuation of the crucial environmental (supporting and regulating) functions of nature ecosystems. These functions are the most important for biosphere stability and sustainable development both on global and regional scales. But just these crucial functions have the worst economic valuation. Environmental functions aren't market services and we have to use indirect methods of their evaluation. Politicians and decision-makers unwillingly perceive such arguments. That is major cause of continued destruction of biodiversity.

One extra way of knocking until they hear is to produce direct evidence of crucial value of supporting and regulating ecosystem functions in monetary form. With that end in view we propose a damage-based approach to their evaluation. The task is the calculation of economic damage (real or potential) as a result of degradation of life-supporting and regulating functions of biodiversity. Degradation of environmental functions of biodiversity causes fires, floods, worsening of water quality, decrease of crop capacity and other negative effects. All these occurrences require money and material resources for compensation of damage.

We want to show what there will be negative profit as a consequence of transformation or destruction of nature ecosystems. This approach takes into account available data about real economic damage because of nature destruction. At the first phase of the project we plan to develop two-dimensional classification, which will combine biological and economic conceptions:

- Classification of life-supporting and regulating functions of biodiversity for the main ecosystems of Russia;
- Classification of kinds of damage because of their degradation.

This classification will connect individual kinds of economic damage and individual kinds of environmental functions of biodiversity for different ecosystems. The next step: determination of methods of evaluation of appointed kinds of damage. At the next phases of the project we plan to elaborate methods of quantitative economic valuation of damage. These stages will include collection of data about costs of activity on damage compensation.

The need for multi-scale assessments in Europe – addressing horizontal and vertical scale interactions

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Summary: The analytical framework of the MA offers some certain challenges for governance approaches concerning in particular horizontal and vertical scale interactions.

The analytical framework of the Millennium Ecosystem Assessment (MA 2005a) presents an important but challenging perspective on biodiversity preservation and nature protection. Whereas it could be argued that it stresses too much the benefits nature provides for human purposes, while disregarding the intrinsic value of biodiversity, it nevertheless highlights the societal relevance of ecosystem services (ESS) in new and quite impressive manner. By revealing the huge diversity of human needs and the variety of societal sectors depending on ESS its analytical framework could help to enlighten about this relevance and therefore emphasis the threats accompanied with its loss.

To reach this aim, however, some major challenges must be addressed. Concerning governance aspects of ecosystem service management, two aspects are particularly important: outcomes from IA must reflect the needs of decision makers to provide proper input. To provide proper input, though, scale and scope of IA must be taken serious.

The first challenge is particular relevant because of the cross-cutting nature of ESS for human well being. Since several societal sectors are touched – from food and agriculture up to recreational purposes and global trade – IA must address this complexity in terms of natural interlinkages and socio-economic interconnections, hence taken horizontal scale interactions seriously. This task is closely linked to the other challenge, the need to reflect scale and scope of IA. Here, the multi-scale approach of the MA is of particular relevance. Following the MA, a multi-scale approach is necessary not only for technical reasons regarding data sampling and evaluation. The MA mentions three other reasons, important for biodiversity governance:

- Firstly, the needs of decision makers at different levels are different, as a "global assessment cannot meet the needs of local farmers" (MA 2003, 43).
- Secondly, the selection of a specific scale is crucial regarding the distributional effects: winners and losers are different at different scales and "the choice of scale is not politically neutral, because the selection may intentionally or unintentionally privilege some groups" (MA 2003, 122).
- Finally, a multi-scale approach enables the evaluation of cross-scale interactions, because conclusions at one scale could be easier reflected at other scales (MA 2003, 43), and similar results on different scales confirm the robustness of the results (MA 2005b).

These notions give profound reasons why sub-global assessments at different scales are so important – and therefore should conduct at different scales within Europe. Another reason was clearly revealed by a study about the relevance of the MA for Germany (Beck et al. 2006). Human well being in Germany, as in most other

industrialised countries in Europe and all over the world, are highly dependent on ESS provided in other regions of the world. From food supply up to regulating services (e.g. climate change) and cultural services (e.g. tourism) social needs and economic purposes in Europe are strongly linked to functioning ecosystem in other regions of the world, while the impact on these ESS are regularly ignored in evaluation and decision making. This kind of externalisation, which can be called trans-regional scale interactions, represents a particular challenge for the governance of ecosystem, too.

In defence of pluralism

Rob Tinch, Environmental Futures Ltd.

Prof. Spash bases his conclusions on two rather extreme interpretations of economics and decision contexts. On the one hand we have a naive "straw man" model of the gung-ho neoclassical economist who "makes no pretence to do anything but be concerned about efficient resource allocation ignoring all other considerations". In fact attention is given to other considerations, in particular intra- and inter-generational equity issues: the distributional aspects of market instruments are widely addressed and debated, for example. Economists' supposed obsession with efficiency is quite simple to explain. The economic definition of an inefficient allocation is a situation in which it is possible to make some individual(s) better off without making any other individual worse off, and the general view is that you'd need quite a good reason not to want to do this. And then it so happens that it is possible to make clear policy recommendations about ways to improve efficiency. The other areas Prof. Spash quite correctly identifies (justice etc.) require more complex treatment, but they are not systematically ignored in the way he suggests.

On the other hand he argues from a utopian view of what our decision support methods should reflect and achieve. Various imperfections with economic methods are noted, quite correctly, but the conclusion - all this is a waste of time, because economic methods are not flawless - is simply not justified. Sure, these methods are imperfect. So are all the other methods! For example, Prof. Spash argues (here in the context of benefits transfer) that "There have been numerous tests and there are serious problems with the approach" - with the implication that the story ends there. Well, yes: there are problems. But that doesn't necessarily imply we should all give up and go home. It may be possible not only to identify problems but also to address or correct for them. Methods are improving, and the research agenda is rich (which is the key point for this e-conference).

To be fair, some economists also use an unrealistic comparator: the baseline of "environment ignored" when economic values are not used (which may have been quite close to the truth when these issues were first discussed, but can hardly be said to be the case now, at least in Europe for public investments). The decision-maker's question for practical application of economic and other tools must be "will this help me make a better decision"? We could (indeed, should, and lots of people do) argue the toss about which methods are "best" under this criterion. The answer will be highly context dependent, and also dynamic: in my view some of the most exciting research (ongoing and in the future) explores interfaces and combinations of "economic" and "non-economic" methods (and sadly this can be hampered by doctrinaire positions on both sides). But whatever we do, we should not lose sight of the inevitability of imperfect assessment with the methods currently, or likely to be in the medium term, at our disposal.

Similarly, Prof Spash confuses tools with their application in specific contexts. For example he argues that "what is clear is that market mechanisms serve only very limited ends". But markets are merely tools for allocating goods and services - they don't serve any ends in themselves. Rather, it is decisions about who holds property rights, and decisions about how and where to introduce markets or other regulations into previously non-market areas, and how to regulate them, which clearly do serve political ends. Equally clearly, these ends are not always limited to efficiency goals. The ultimate goal of carbon trading, for example, is to combat climate change. The

use of a market instrument aims to achieve the reductions in an "efficient" (here meaning least cost) way. The decisions about baselines and allocation of permits are related to equity and associated political goals. That's quite a mix of motives, and to reduce it all to "efficiency" is neither accurate nor helpful.

Prof. Spash flags up the various real challenges to economic approaches arising from behavioural psychology and other fields. For example, he cites work suggesting that people "express plural often conflicting values". It would, of course, be churlish of an economist to criticise anyone for an inability to make up his or her mind. But it's fair to point out that "conflicting values" are a challenge for any method aiming to take values into account, not just the economic methods. Discursive methods (which ones? research question...) are probably better than economic methods at helping people to clarify their values: they may or may not (another research question...) be better at providing input for decision support.

It's important not to lose sight of the "meta-problem" that we have huge numbers of decisions to make, and that all methods of decision support are costly, to different degrees. The best decision might arise after comprehensive consultation, focus groups, citizens' juries, interactive and iterative testing of multi-criteria models... but this demands time and resources, not least from members of the public who may quickly become fed up with excessive burdens of consultation. Depending on the decision context, we might get a decision almost as good, and a lot faster and more cheaply, from a quick and undeniably dirty benefits transfer exercise. It's "horses for courses" and a large part of the research agenda should be aimed at evaluating the horses, assessing which courses each runs best on, and selectively breeding to improve the stock. In doing so we should never lose sight of the needs and desires of stakeholders and decision makers, but we do this not in some utopian setting in which people have infinite patience and cognitive capacity, but in a warts 'n' all world in which stressed decision makers use flawed methods in budget constrained exercises to assess the views of busy stakeholders with unclear and/or conflicting values. We'll achieve the goals best if we continue examination of all the methods, including new methods and (especially) new combinations of old ones, to establish the conditions under which each is most appropriate.

In summary, Prof Spash makes a lot of good points, and I agree with most of the evidence he cites, but his conclusions are not justified. In his haste to toss the baby out with the bathwater he risks defenestrating the bath, the tiles and a good fraction of the plumbing into the bargain. And, from both applied policy and research agenda perspectives, that would not be efficient.

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