Actions for the 2010 biodiversity target in Europe– how does research contribute to halting biodiversity loss?

Report of an electronic conference, October 2006

E-Conference organisation:

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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 "Actions for the 2010 biodiversity target in Europe– how does research contribute to halting biodiversity loss?" preceding the EPBRS meeting to be held under the Finnish EU presidency in Helsinki, Finland from the 17th to the 19th November 2006.

Introduction

Jari Niemelä

Recent assessments of the status and trends of world's biodiversity indicate that biodiversity and consequently ecosystem services provided by biodiversity are in decline. However, there is hope that such negative trends can be changed. The EU has made significant commitments to reverse biodiversity decline by agreeing 'to halt the decline of biodiversity by 2010'. Although there are signs of slowing rates of biodiversity, the pace and extent of implementation has been insufficient (Halting the loss of biodiversity by 2010 – and beyond, COM(2006) 216 final). The Communication states that the achievement of the 2010 target is still possible but will require accelerated implementation.

The aim of the Finnish EPBRS meeting (in Helsinki 17-19 November 2006), therefore, is to provide material that will help the EU and international policy processes to accelerate the implementation of measures to halt the biodiversity loss by formulating more precise expectations on biodiversity research and policy. Science in support of the 2010 target should focus on research that will inform policy and practice relating to biodiversity conservation, agriculture, the built environment, water resources, and coastal and marine management. Enhanced collaboration between researchers and policy-makers is a key to success in halting the loss of biodiversity, and promoting such collaboration is one of the main goals of the Helsinki EPBRS meeting.

The Finnish EPBRS meeting is structured around one general issue and two focused ones. 'How to reach the 2010 -and beyond - target: research influencing policy' is the overarching theme of the meeting, while 'Youth and biodiversity' and 'Urban ecology and biodiversity' are emerging biodiversity issues important for the EU. This electronic conference is organized to discuss these three issues.

The e-conference chairman for the first issue 'How to reach the 2010 – and beyond – target' is Dr Terry Parr (CEH). The issue is further divided into three topics:
- Effects of research on biodiversity policy including examples of best practice
- Communication gaps for the use of biodiversity research to halt the loss of biodiversity
- Three most important research topics for halting biodiversity decline and their justification.

The second issue 'Youth and biodiversity' focuses on biodiversity in school education. The e-conference chairman for this issue is Professor Mauri Ahlberg (University of Helsinki). The session has two topics:
- Innovations to promote biodiversity by co-operation of teachers and scientists
- Schools as activators of the monitoring of environmental change.

The e-conference chairman for the third issue 'Urban ecology and biodiversity' is professor Stephan Pauleit (Centre for Forest, Landscape and Planning, Royal Veterinary and Agricultural University, Denmark). This session will focus on the status, trends and research needs in urban biodiversity in Europe.

I hope you enjoy and participate in the electronic conference which will feed into the November EPBRS meeting.

Summary of contributions

Terry Parr, Stephan Pauleit and Mauri Ahlberg

How to reach the 2010 target and beyond

The main aims of this E-conference were to identify the most important research topics for halting biodiversity decline and to explore knowledge transfer and communication gaps, particularly with policy. We will have to wait until the results are discussed at the EPBRS meeting in Finland in November for a complete analysis of the contributions in relation to the match between current research and policy priorities. However, the response to this E-conference shows that interest in biodiversity a research and policy has never been greater. This reflects an ongoing commitment to biodiversity conservation in protected areas but also a growing recognition of the role that biodiversity plays across many sectors of society and in the wider seascapes, landscapes and urban areas.

1. Priority Research Areas
Initial priorities for research were identified in the SYKE report summarising the results of an EPBRS/ALTER-Net questionnaire. Many of the contributions to the E-conference supported these main areas of research but there were some important shifts in emphasis emerging. These are summarised below.

Priority Research Area 1. Improve understanding of the major anthropogenic and natural drivers of biodiversity change, and their individual and combined impacts.
The E-conference provided a few mentions of key pressures on biodiversity, particularly climate change, but the main emphasis was on management of biodiversity inside and outside of protected areas. Inside protected areas the need was for more research to facilitate adaptive management. But with the recognition that only a relatively small proportion of land (15%) is in protected areas there was a great deal of interest in research to look at biodiversity in relation to cross-sectoral issues. In particular, actions to mitigate human effects on biodiversity and identify "win-win" options where biodiversity could benefit from policies in other sectors. The need for a

better understanding and management of agriculture-biodiversity interactions was repeatedly stressed but other concepts such as "eco-enterprises"; "systematic conservation planning" and "creative conservation" were also put forward.

Several contributions made the general point that the fate of biodiversity inside and outside of protected areas depends ultimately on the feedbacks between ecological, social, economic and political systems and these are weekly covered thirdly. The research questions here are usually complex, often neglected, and must be handled in an inter-disciplinary way. More effort needs to be put into articulating appropriate research questions and building research capacity in this area.

Priority Research Area 2. Develop, test and evaluate indicators, including indicators of sustainable management of renewable resources, ecosystem goods and services, and public awareness, to deliver policy-relevant information.
The E-conference revealed a continuing interest in research on indicators. But there was a general dissatisfaction with simple indicators of state, usually because these rarely appeared to stimulate appropriate management or policy responses to prevent biodiversity loss. Hence, research on indicators that link more directly to management actions and policy responses was seen as the main priority and this included ideas in relation to indicators of biotic integrity, indicators of unfavourable status, indicators of ecosystem services and sustainable management, and indicators of the effectiveness of management and policy actions.

Research on the relationship between biodiversity and ecosystem services was also seen as a key issue in order to gain more public and political acceptance for action.

Priority Research Area 3. Further develop an accessible Europe-wide inventory of species and habitat distribution, status and trends, underpinned by significant new taxonomic effort, and support similar research in developing countries.
In relation to this priority, there were several calls to fill taxonomic knowledge gaps and for improved inventories of species and habitats and genetic biodiversity, particularly in the coastal and marine environments. In the marine environment the lack of systematic habitat survey information and a general under-sampling of the biodiversity was seen as a major barrier to preventing further biodiversity loss. On the positive side, there were statements of strong support to build on the work of Global Biodiversity Information Facility by improving its data coverage and exploiting its expanding database in research and policy.

2. Knowledge transfer, the policy interface and communication gaps
Early in the E-conference a provocative statement was made saying that we already know enough about biodiversity loss for policy purposes and that the priorities are now to develop cost effective management options, understand and find more effective methods for getting science to contribute to policy and develop incentives that turn awareness into action.

This debate simmered gently along throughout the conference without really coming to a boiling point. The general level of response to the question of research priorities (above) showed that there was still a perceived need to expand the knowledge base but equally there were many contributions that stressed the development and use more effective tools for translating knowledge into action. A quote from John Lawton: "conservation is not about science" further stimulated the debate.

This is a complicated area, but the suggestions fell into 3 broad areas:

1) Specific proposals to develop and make use of existing tools for biodiversity management and planning.
2) Research on public attitudes to determine what the main factors are that determine whether the public actively support, accept or ignore of particular policy or management measures.
3) Proposals to develop a more effective science policy-interface. Since any such interface would be complex, multi-directional, with many players at different levels of interest, one proposal was to establish an effective co-ordination process across the whole biodiversity community. An on-line data-base linking research to policy (and vice-versa) might form part of this.

3. Does halting the loss of biodiversity begin at home?
This was a European E–conference so not surprisingly we had few contributions from outside Europe. More surprisingly there was little discussion of the impact of European policies on biodiversity in other parts of the world so perhaps this is a research-policy gap that needs further discussion.

Urban biodiversity

1. Status and trends of urban biodiversity:
This was not the main topic of the E-conference, which concentrated rather on research needs and priorities for action. Moreover, this topic was dealt with in the questionnaire action that preceded the conference and which was summarised by Jari Niemelä at the beginning of the conference. However, the following points were mentioned:

Status:
Urban areas can have a higher biodiversity than surrounding countryside which is often impoverished due to intensive farming. A study of German cities shows that they are often located in areas which are naturally rich in species due to geological diversity, and this pattern explained high urban biodiversity (see Ingolf Kuehn's contribution).

Within urban areas, there is a gradient from species poor inner urban areas to the urban fringe with a relatively high biodiversity. This is particularly due to the diverse mix of different land uses (with their distinctive open spaces), and remnants of encapsulated countryside which have survived in urban areas. Introduced species also contribute to urban biodiversity. However, the general model of the urban – rural gradient significantly differs between cities due to their history and the specific pattern of urban structures and land uses (see contributions from Jonathan Sadler and Robbert Snep). Therefore, a more detailed look at the urban mosaic is required to gain a better understanding of ecological pattern and process.

Pressures:
While urban biodiversity can be generally high, native and archaeophytic species are under pressure due to urbanisation and the consequent loss and fragmentation of natural and seminatural habitats. Moreover, T. Kucera explains in his contribution that remnants of seminatural habitats suffer from lack of traditional management. As a consequence, urban biodiversity may decline and species assemblages may become more homogeneous between cities due to the loss of locally distinctive (and rare)

species, on the one hand, and the increase of common and introduced species, on the other. Further urban development will increase these pressures, e.g. through the intensification of land use within urban areas and urban sprawl.

Certainly, much more would need to be said to gain a more accurate and differentiated view on status and trends of urban biodiversity. However, a limitation is that comprehensive and comparable assessments of urban biodiversity are mostly missing, not to mention the lack of time series.

2. Needs for research and action:
In his introductory note, Jari Niemelä listed eight topics for research that were mentioned in the preceding questionnaire action via ENULE.
1. Development of standardized methods and indicators across Europe for comparative assessment/monitoring of urban biodiversity.
2. Functioning of urban ecosystems incorporating the human dimension.
3. Effects of habitat fragmentation, role of urban ecological corridors.
4. Can you build for biodiversity in urban areas?
5. How important are private gardens to biodiversity.
6. Urban ecological research in urban planning and design.
7. Relevance of urban green space for the urban dwellers.
8. Measures needed for halting the loss of urban biodiversity in Europe.

These topics served as a basis for the e-Conference. Contributions were particularly concerned with:

Comparative research in urban areas:
It was suggested to launch an EU-wide research project using a comparative approach by conducting similar kind of field work along urban-to-rural gradients in many cities across Europe based on standardized methods and common indicators. The GLOBENET project was mentioned as an example (see contributions from Jari Niemelä and Lyubomir Penev).

The proposal for comparative research was welcomed by several contributors. Susanna Lehvävirta made the point that such research should go beyond the study of general broad ecological phenomena/ patterns of urban areas (e.g. urban-rural gradients). The aim should be to identify causal mechanisms producing these patterns, and she suggested that such research should focus on particular, well-defined research questions and it can be undertaken on a smaller scale. Current research on the impacts of trampling and edge effects on biodiversity in urban woodlands in Finland was given as an example. This research should lead to planning and management guidelines, and the development of decision support tools (see contributions from Fabio Attorre and Jonathan Sadler).

Urban form, human activities and natural process: landscape ecology of urban areas:
There is increasing evidence on ecological gradients between urban and rural areas. However, urban areas are in reality a complex mosaic of distinctive urban structures that accommodate different urban land uses/ human activities (see contributions from Ingolf Kuehn, Robbert Snep, Jonathan Sadler). Jonathan Sadler pointed out in his key note that "it is now time to look past the (generic urban – rural gradient) and focus on the details of the mosaic" in order to understand the causal mechanisms that lie behind the occurrence of species in urban areas (and I would like to add: and other environmental process such as hydrology, urban climate etc.). Little is known on the role of the urban matrix (and its different land uses) as a habitat and in which way it

enhances or hinders dispersal of species in urban areas. What are effective corridors for species dispersal in urban areas? Landscape ecology has mostly concentrated on rural areas, but it is still at the beginning in urban areas (see contribution from Robbert Snep). Consequently, there is a lack of guidance to apply landscape ecological principles in the planning, design and management of urban areas.

Integrated research:
Several contributions stressed that true understanding of the urban ecosystem requires close cooperation between natural and social sciences as well as between science and practice. Urban areas are the human habitat in the first place. They are developed and managed to meet human needs and fulfil functions for human society. Therefore, it is crucial to understand how and why humans behave and act in urban areas, what are the value structures behind (see, for instance Frank Waetzold's contribution in the 2010 Target session), and link this to ecological process. In particular there is a need to understand planning/ design and decision making in order to produce knowledge, indicators, tools and guidance that are relevant to them (see contribution of Paul Opdam in the parallel session on 2010 Targets). For planning, for instance, it will be important to better understand the ecological performance of urban land use types and how parameters that can be influenced through planning and design (e.g. urban density, green space provision, etc.) impact on natural process (biodiversity but I would also like to add hydrology, climate, among others). I would like to stress the need for close, and open minded collaboration with landscape architects, engineers and the managers of open spaces because it is them who translate goals into the physical design and management of open spaces. I felt during the session that more was said about understanding the attitudes of residents towards biodiversity but less so on the important role of this group of landscape architects, engineers etc.

Such integrated research is still the exception because it is so challenging. From a multidisciplinary project in Birmingham, Jonathan Sadler reported that it may take several years before researchers from different disciplines have learned to cooperate with each other and are able to interact with the network of actors in an urban redevelopment project.

Several other contributions underlined the need for integrated research, and gave links to projects (e.g. Sandrine Godefroid, Richard Scott).

3. Public involvement in preserving urban biodiversity:
It was noted that urban biodiversity can only be promoted when this ambition is broadly supported by the public. Urban ecology is until now still mostly based on "experts" knowledge whereas little is known about the attitudes of the citizens towards biodiversity. How is biodiversity perceived and valued? Research in Swiss urban areas showed that green spaces are assessed according to criteria such as access, stimulation and attractiveness but there is little direct interest in species per se (see contributions of Robert Home). Irina Herzon therefore asked to "improve understanding and appreciation of urban green space, and in particular biodiversity, by residents". Education was seen as important to raise the interest of the youth in biodiversity. Yet, much depends on how the public is engaged in conservation projects. Richard Scott from Landlife reports that "creative conservation" projects are very successful in England to raise the interest of citizens in wildflower landscapes, and increase the level of outdoor exercise. Unfortunately, these projects are not recognised in conservation policies such as Local Biodiversity Action Plans. It seems

that national and local conservation policies are not sufficiently encouraging wider involvement of the public in biodiversity issues.

Thomas Elmquist too stresses in his keynote the important role of the public in the protection and management of green space and biodiversity. An impressive number of 69 NGOs are involved in the management of the National Urban Park, a large woodland area located within Stockholm. Analysis of these organisations demonstrated their important role in protecting the National Urban Park from urbanisation pressures, either through direct involvement in the management of the park or indirectly through awareness raising and providing legitimacy to the more directly involved groups. Moreover, the stakeholder groups are important for introducing new forms of adaptive management because they may be more open to experimentation and learning than government organisations.

Youth and Biodiversity

The title of our session of the e-conference "Youth and Biodiversity" was criticized for being too narrow and inaccurate. According to the digital Oxford English Dictionary, the word 'youth' has six main meanings, the most prominent one being: 'young people collectively', "more specifically, the period from puberty till the attainment of full growth, between childhood and adult age." It was suggested that all people, the whole of humankind, needed biodiversity education and learning.

The main results from the e-conference are presented in order of the seven issues discussed during the e-conference:

1. Innovations to promote biodiversity education through the co-operation of teachers and scientists.
At least the following concrete innovations including research priorities were presented:
(a) Use of competitions on European Biodiversity among schools (including the public) could promote our biodiversity learning and education. At least, it deserves to be tried, tested and researched.
(b) Use of the WAP Browser technology as part of Mobiles for future "public biodiversity monitoring"
(c) 'The Stack' is an e-learning environment that promotes basic and advanced skills in species identification – its primary objective is to improve the quality of biodiversity training of university students in biology.
(d) Use of Geographical Information System (GIS) in connection to biodiversity education, e.g.: How best to use Geographic Information System (GIS) and Geographical Positioning System (GPS) to promote biodiversity education?
(e) NatureGate, a project which integrates all above mentioned ideas, for lifelong biodiversity education, is in progress. It cooperates with ESRI, which is one of the leading commercial companies of GIS and GPS applications. NatureGate will include a network of servers with digital libraries of high quality photographs of organisms and their habitats, biotopes, ecosystems, and fast digital software for fast and easy identification of organisms. The organisms can be grouped in all possible ways, including any kinds of groups or stacks, including threatened, or keystone species etc. In Biodiversity Education, results of both competitions and collaborative knowledge building can be cumulatively stored, shared, used, distributed, and continually further developed using modern computer soft ware (1) for GIS, and (2) for collaborative knowledge building, e.g. CmapTools.

General hopes were expressed about for example, the need to develop (a) teaching methods focusing on interactions and processes; (b) teaching models where students identify keystone process species in the ecosystem, and build an understanding of the functioning based on these few but important organisms; and (c) better incorporation of conservation issues into teacher-training programmes. The last suggestion was made by a participant not involved in teacher education programs. The point is that those, who are working inside teacher education, know that there is no space for conservation issues in teacher education programs of modern knowledge societies. Biodiversity education has be a part of something bigger, e.g. Education for Sustainable Development (as a part of UN Decade of Education for Sustainable Development, 2005 – 2014), and even then mostly as extracurricular digital material in the WWW.

2. Schools as activators of the monitoring of environmental change and biodiversity
We learnt that schools are already activators of the monitoring of environmental change and biodiversity. They can be helped by innovations presented above.

3. What is the current position of biodiversity education in general education, in vocational education, and in adult education?
We learnt that there are some activities going on in each of these fields, but plenty of room for improvement. Above innovations outline how biodiversity education could be promoted in all of these fields of education.

4. Citizens as collectors, co-builders and users of biodiversity knowledge.
We learnt that citizens can be activated to take part and to promote biodiversity and biodiversity education. This is happening in the international Scout Association movement, in the German NAJU (NAJU (Naturschutzjugend) project and in the international NatureGate R&D program.

5. Co-operation with scientists, teachers, civil servants, policy-makers and schools in promoting biodiversity (problems and solutions of communication).
We learnt that, for example, the international ENSI-project (Environment and School Initiatives) is co-operating with scientists, teachers, civil servants, policy-makers and schools in promoting biodiversity. There are, however, most probably problems and solutions of communication yet to be researched.

6. What are the gaps in our knowledge and understanding of biodiversity education and learning?
One important gap in our current knowledge is how to connect urban life style people with biodiversity protection. Many young people are alienated from non-urban, rural nature. Does use of new communication technology provide any help?

We do not know the efficiency of three proposed theoretically ways to promote biodiversity education, namely inquiring learning, collaborative knowledge building, and their combination. They can be used in formal, informal and in non-formal education, in kindergarten, in schools, in universities and in adult education. But how efficient are they compared to other options, e.g. simply delivering information about biodiversity losses using mass media?

How do quantity and quality of nature education relate to understanding and appreciation of biodiversity? Does a week in the forest add more to the understanding and appreciation of biodiversity than a weekly program on school TV? How can the

so-called "significant life experiences" be promoted? Probably the best way would be integrating inquiries in nature with learning from cumulative global knowledge from internet, and taking actively part in building knowledge on biodiversity, collaborating with biologist, using a shared dedicated servers like NatureGate. Everybody can make observations on organisms, take digital photographs of them, and upload them. Nobody knows. Everywhere biological nature in its various ways is very exiting for those who have time and the interest to experience it.

We do not know how good NGOs are in promoting biodiversity education and learning. An example is the Austrian Network for the Protection of indigenous Orchids, founded in 2005. The vision is that participating people will learn about the mechanisms of evolution, the global distribution of plants, the function of ecosystems, about modern systematics, including molecular phylogenetics, and about the importance of the preservation of all species and their biotopes.

How efficient are open-ended problems that engage deliberation and action in student? How useful are biodiversity problems that could connect with the conflicts of interest that students find meaningful to deliberate and act upon in biodiversity education?

How useful and efficient is it to present an integrating, collaborative knowledge building approach, search for balanced interests, and search for win-win strategies for the whole of humankind?

Some people are better at "reading nature" than other. There is a big variation. One important research issue and a gap in our knowledge is how to best teach people to identify and recognize important species and other taxons and their interrelationships in ecosystems, and how to develop best practice, and test competence of 'reading nature' in both urban and rural environments.

7. What is strategically important research that should be undertaken for promoting biodiversity education and learning?
We need both theoretical and empirical research on biodiversity education and learning, in order to promote the field. Confused or simplistic thinking results in confused, and/or simplistic empirical research. Problems of biodiversity conservation and biodiversity education are really complex, and therefore research, both theoretically and empirically, has to be advanced enough to deal with this complexity. We always need collaboration of those people we are developing research on and with. If we want to say something meaningful about biodiversity education and teacher education, then it is best to ask relevant teacher educators to collaborate.

The first research priority should be: How can the Tree of Life, or any other global network of servers, be developed into real global network of biodiversity servers promoting biodiversity learning of all humankind?

If we agree that the most important issue is to activate the whole humankind, then the NatureGate type approach could be the focus of strategically important research that should be undertaken for promoting biodiversity education and learning.

Connected to the global network of biodiversity servers, we need cumulative research on what people learn and think about organisms, biotopes, and ecosystems, and all other aspects of biodiversity. Digital resources, photographs, documents and videos, they attach the servers, e.g. by using CmapTools, would be extremely revealing material for future research on biodiversity conservation and biodiversity education and learning

We need research on how people are conserving or promoting biodiversity around the world. What are they thinking, what are they learning when trying to conserve or promote biodiversity?

We know that digital storage space is becoming cheaper. Internet connections are becoming faster. Mobile technology, GIS, etc are improving. It is a very important research priority of biodiversity education to promote research on these issues and in particular how they can be used to promote the global, cumulative network of biodiversity servers for research on biodiversity learning, thinking and action.

Research and development on creating integrated internet serves (E.g. NatureGate), in which GIS can be used as well as modern digital mobile technology. There data could be collected collaboratively by all citizens, and biodiversity knowledge could be collaboratively built. An important question is how people in practice integrate facts and values for real world decision-making in the face of factual and ethical complexity.

How could all the above described activities happen in reality, and how could biodiversity education be best promoted for the benefit of all humankind. This is strategically the most important research that should be undertaken for promoting biodiversity education and learning. In order to promote for biodiversity education research, it is strategically important to have both (a) local biodiversity research and education centres and (b) collaborative knowledge building, sharing and spreading centres that are using the Internet and the WWW, e.g. NatureGate.

Final suggestions

A particularly good idea, that deserves to be thoroughly discussed, is a proposal for a "UN Decade of Biodiversity" (2011- 2020) to promote biodiversity conservation and biodiversity education beyond the 2010 target. There ought to be plenty of research to monitor and continually improve quality of activities during this decade.

All this can be continually integrated using proposed network of Internet servers, e.g. NatureGate. The point is that lifelong Biodiversity Education needs integration of Biodiversity information delivering, sharing and collaborative knowledge building, integrating use of latest Information and Communication Technology (ICT). It needs plenty of biological and educational research to create this kind of network and continually improve it.

Research priorities

Juliette Young and Allan Watt

How to reach the 2010 target and beyond

1. Assessing species and habitats status and trends:
- Further develop an accessible Europe-wide inventory of species and habitat distribution, status and trends, underpinned by significant new taxonomic effort.
- Identify, harmonise and compile currently available long-term time series, inventories and taxonomic data with the aim of identifying gaps in data
- Develop methods to make existing data more widely accessible to all users.
- Promote detailed habitat mapping to support conservation and sustainable management practices.
- Develop a consistent European-wide system of habitat classification (i.e. European Union Nature Information System) as well as evaluation systems for the trends of Natura 2000 sites.
- Develop population ecology of threatened species including research on minimum viable population size and area.
- Promote research on the impact of the reintroduction of species and restoration of habitats
- Promote research on the genetic diversity of threatened species.
- Assess present losses of species diversity and restoration of ecosystems in view of selection of reference sites.
- Develop, test and evaluate indicators, including indicators of sustainable management of renewable resources, ecosystem goods and services, and public awareness, to deliver policy-relevant information.
- Promote the use of existing tools (Natura 2000 for the community-ecosystem level and Red List for the species level) as indicators of biodiversity trends.
- Using a selection of indicator species, assess population status and trends for species in the Birds and Habitats Directives.
- Explore the potential of GBIF in allowing countries to develop their own estimators of biodiversity loss, and compliance with the 2010 target.

- Improve estimators ("surrogates") for overall biodiversity (including estimates of marginal gains/losses rather than estimates of total species numbers in a given place). Such approaches should include making best-possible use of museum collections data and integrating such information with environmental layers. Estimation methodology would greatly help in eliminating the distortions in "real data" introduced by sampling methods.
- Explore how a rapid, large scale DNA barcoding program might be used for conservation planning for 2010
- Develop future scenarios by experiment and testing the adaptive potential of both individual keystone species as well as at the mesocosm level.
- Explore links between biodiversity or habitat loss and demonstrated loss or degradation of ecosystem services.
- Assess the roles of public beliefs, perceptions and attitudes in biodiversity loss.

2. Drivers of biodiversity change:
- Improve understanding of the major anthropogenic and natural drivers of biodiversity change, and their individual and combined impacts.
- Assess impacts of harvesting and other potentially unsustainable practices on ecosystems and their functioning.
- Evaluate the effectiveness of existing conservation policies and the impact of policies from agriculture and other sectors
- Evaluate the impact of key agricultural activities on biodiversity conservation. Based on these outcomes, models for land use scenarios can be validated.
- In the marine environment, increase research on the effects of local disturbance, fisheries and global climate change at the appropriate scales in order to understand resilience and adaptability of marine populations and communities.
- Understand how changing conditions (climatic, socio-economic) influence not only ecosystems directly, but also human demands on systems, services obtained, and values of those services.
- Explore how people and industry respond to different policy instruments aiming to address biodiversity loss, and how this interacts dynamically with ecosystem process and services.
- Promote research to develop adaptive measures for biodiversity and climate change in all terrestrial, coastal and marine areas within the jurisdiction of EU member states.

3. Values of biodiversity
- Develop methods for the valuation of biodiversity, including ecosystem goods and services and their contribution to livelihoods.
- Assess the role of biodiversity on health and disease incidence.
- Produce realistic estimates of opportunity costs of conservation, and their distribution, including ways to combine different costs.
- Estimate the values of coastal habitats to provide real estimates of the ecosystem services that they provide.

4. Biodiversity management:
- Assess the role of Natura 2000 in adequately protecting European terrestrial and marine biodiversity and accommodating expected climatic changes with resulting shifts in species' ranges

- Develop methods to integrate environmental change into conservation planning and incorporate landscape and land-use dynamics into habitat management options.
- Compare habitat distributions with the existing protected areas to identify and fill gaps in protection.
- Identify ways to maintain viable species populations with large enough patches or connectivity.
- Develop methods to promote a more ecosystem-based management approach (for example Integrated Coastal Zone Management).
- Research on public attitudes to determine what the main factors are that determine whether the public actively support, accept or ignore particular policy or management measures.
- Develop methods to better incorporate stakeholder input in appraisal methods, including better consideration of winners and losers, and conflict resolution methods

5. Linking research with policy
- Increased research on the understanding of public attitudes and views on biodiversity and biodiversity management to develop and present arguments for a comprehensive approach for ecological outcomes that are both socially and environmentally effective.
- Develop methods to encourage direct and continuous dialogue with decision-makers (e.g. 'research ambassadors').
- Research into indicators and decision-support tools to translate knowledge on ecosystem services into useful measures for decision-makers. Research topics include: better methods of presenting and managing uncertainty; benefits transfer and aggregation issues; relative merits of (and synergies between) discursive and monetary valuation methods
- Investigate the role of environmental ethics in communicating the current risks to biodiversity.
- Develop methods to promote greater involvement by NGOs and community groups
- Develop methods to incorporate private as well as governmental actions engaging the private sector for areas such as agriculture, fisheries, marine shipping, tourism alternative and renewable energy.
- Identify ways to promote eco-enterprises and encourage biodiversity-friendly innovation
- Identify methods for the quantification of delivery of public biodiversity goods by companies
- Further develop mechanisms to promote interdisciplinary research between ecological, social and economic disciplines, as well as planning and design disciplines.
- Develop methods to design and implement coordination of EU-level stakeholders engagement processes in EU research projects and networks
- Develop mechanisms to include local knowledge into scientific generic tools.

Urban biodiversity

1. Relevance of urban green space for the urban dwellers.

- Improve understanding of the attitudes of urban residents towards urban green spaces, and in particular to biodiversity
- Develop methods to encourage urban green space (including urban aquatic zones) both as learning areas and for biodiversity per se.
- Improve understanding of the role of urban biodiversity in shaping people's understanding of global biodiversity conservation.

2. Functioning of urban ecosystems.
- Develop research on the role of connectivity and linkage in urban ecosystems.
- Identify current and potential native, natural and semi-natural habitats as well as their connection with the green structures and corridors to the surrounding nature.
- Promote research on habitat patch and habitat matrix.
- Understand how urbanisation affects interactions between species and the physical properties of landscape
- Determine which processes are scale invariant or scale dependent.
- Better understand the complexity of ecological interactions and how they vary in relation to urbanisation.
- Explore the potential for 'green engineering' the built environment in a manner that maximises its ecological function.

3. Effects of human activities, such as habitat fragmentation, on urban ecology and biodiversity.
- Establish the role of disturbance in urban ecology.
- Establish how the density of the built form affects habitat / ecosystem performance in terms of its effect on key processes (e.g. run-off retention, nutrient cycling and so on).
- Research on understanding social-ecological complexity

4. Development of standardized methods and indicators across Europe for comparative assessment and monitoring of the state and trends of urban biodiversity.
- Develop robust indicators, new ways of capturing and representing data (e.g. in GIS models), and modelling tools (e.g. decision support systems, spatially-explicit species models).
- Detailed studies on precise, spatially explicit patterns of distribution and species composition within cities and among cities using a common framework with finer resolution but larger extent (e.g. Europe)

5. Integrating urban ecological research into urban planning for the maintenance of biodiversity in urban areas.
- Exploring the role of adaptive capacity in light of environmental change
- Better understand the conditions needed for more effective ways to manage urban ecosystem services.
- Promote the development of an integrative view of the whole urban socio-ecological landscape.
- Develop adaptive governance systems to support practical management.
- Promote mechanism-oriented (instead of being taxon-oriented) research to further develop urban ecological theory and provide effective planning and management guidelines.
- Promote ways in which to encourage interdisciplinary research in urban ecology

- Develop methods to present scientific findings in a comprehensible and accessible way

Youth and biodiversity

1. Biodiversity education in schools:
- Develop teaching methods focussing on interactions and processes.
- Develop teaching models where students identify keystone process species in the ecosystem, and build an understanding of the functioning based on these few but important organisms
- Increase interest in biodiversity by using particular charismatic species (e.g. orchids) or habitats (e.g. rock pools and seashores) to encourage practical Biodiversity Education.
- Develop better incorporation of conservation issues into teacher-training programmes.
- Promote methods to foster the cooperation of the formal school system in biodiversity education.
- Study the circumstances that enable innovations in schools, particularly the role and participation of pupils in developing new models.
- Research to determine which pedagogical methods could best be applied to the teaching of GIS in schools.
- Provide more support to teachers through social recognition, better internet resources (e.g. databases) and material conditions
- Promote closer collaboration of educational scientists and teachers in developing, testing and evaluating biodiversity education tools.
- Promote the involvement of parents in Biodiversity Education
- Promote competitions on European Biodiversity among schools (including the public)
- Gather data on the state of alienation of young people from biodiversity in different parts of Europe and on the links between alienation and educational programmes.

2. Informal biodiversity education:
- Promote general informal biodiversity education through, for example, new virtual media (NAJU project) or the voluntary sector (the Scout Association)
- Promote the use of non-traditional approaches to Biodiversity Education, such as WAP Browser technology in mobile phones for mapping and/or species identification, GIS, the use of handheld GPS and the BioBlitz initiative of counting as many species from as many taxonomic groups in a 24-hour time period.
- Develop lifelong learning mechanisms
- Explore the potential for biodiversity education of involving school children in biodiversity management
- Develop methods to promote communication through intergenerational relationships and scientific actors in order to foster conservation.
- Promote biodiversity education through the integration of well-organised information resources with outdoor activities and re-connecting in multiple ways to nature

- Develop ways to encourage the "educational chain" between children, parents, family and business through practical field work/observations, collaborative knowledge building and the exchange of experiences.

3. Biodiversity education resources:
- Develop major, well-funded, long-term cumulative research programmes in order to promote biodiversity education.
- Promote the development of a of global network of biodiversity servers around the world building on existing networks to easily deliver and access biodiversity information for all users
- Promote the development of interactive tools such as websites with photographs and videos of species and habitats.
- Produce indicators of biodiversity learning, thinking and action
- Promote research on the potential of new media in biodiversity learning, thinking and action.
- Research on the identification of connections were human interests seem to collide, but where deliberation can help us find possibilities and solutions.
- Foster the concept of a "UN Decade of Biodiversity" to maintain momentum of biodiversity conservation beyond the 2010 target.

List of contributions

Urban biodiversity

Youth and Biodiversity

How to reach the 2010 target- and beyond

How to reach the 2010-and beyond-target: Research influencing policy

Terry Parr, E-Conference Chair, CEH Lancaster, UK

Welcome to the Finnish EPBRS e-conference session on 'Actions for the 2010 biodiversity target in Europe – how does research contribute to halting biodiversity loss?"

In this E-conference we will continue the task laid out by Jari Niemela in his introduction. In summary, the aim is to enhance collaboration between research and policy makers and to identify research practices and tasks to support the development and implementation of an effective and socially acceptable biodiversity policy. Over the next 3 weeks we will try and identify the essential research and development required to ensure that biodiversity and the services it provides can be protected and enhanced up until 2010 and beyond. Many would argue that achieving the 2010 target was always going to be an impossible dream, but it is also apparent that the target has already served a useful role in focusing policy and research priorities. We now need to continue this process and look beyond 2010 to create a longer-term framework for policy and research on biodiversity.

STRUCTURE OF THE E-CONFERENCE

Day 0. We will start by summarising current research priorities and their link to the 2010 target by presenting the results of the survey has been developed jointly by European Platform for Biodiversity Research (EPBRS), ALTER-Net (A Network of Excellence on biodiversity Research) and the Finnish Environment Institute (SYKE). This questionnaire was based on a comprehensive list of important research topics presented in the 'Message from Malahide' and the results represent the views of EPBRS members and participants in the biodiversity related networks of excellence, ERA-Nets and national biodiversity platforms.

Day 1- 14. But do these research priorities really reflect policy priorities? The bulk of the E-conference will be made up of a structured discussion designed to explore how well current research priorities meet the policy priorities related to the 2010 target. The framework for this is provided by the key policy areas for action identified in the Communication from the Commission (COM(2006)216final) on "Halting the Loss of Biodiversity by 2010 – and beyond". This lists 118 specific actions related to 10 policy objectives in 4 policy areas:

Policy Area 1: biodiversity in the EU
Objective 1. To safeguard the EU's most important habitats and species.
Objective 2: To conserve and restore biodiversity and ecosystem services in the wider EU countryside.
Objective 3. To conserve and restore biodiversity and ecosystem services in the wider EU marine environment.
Objective 4: To reinforce compatibility of regional and territorial development with biodiversity in the EU.
Objective 5. To substantially reduce the impacts on EU biodiversity of invasive alien species and alien genotypes.

Policy Area 2: the EU and global biodiversity
Objective 6. To substantially strengthen effectiveness of international governance for biodiversity and ecosystem services.
Objective 7. To substantially strengthen support for biodiversity and ecosystem services in EU external assistance.

Objective 8. To substantially reduce the impact of international trade on global biodiversity and ecosystem services.

Policy Area 3: biodiversity and climate change

Objective 9. To support biodiversity adaptation to climate change.

Policy Area 4: the knowledge base

Objective 10. To substantially strengthen the knowledge base for conservation and sustainable use of biodiversity, in the EU and globally.

The Communication provides a neat set of objectives with some clear policy actions and leaves some key questions for the research and policy communities to consider:

Q1) What research and development is required to enable us to meet these specific objectives? Do we already know everything we need to know to implement these policies and are improved knowledge management, knowledge transfer and communication strategies the main priorities? Some might say so. But others might point out that biodiversity is such an integral part of our lives that it effects and is affected by almost everything we do. We may only have a small part of the knowledge base necessary to manage these complex interactions between biodiversity and society and we require new integrated, inter-disciplinary, cross-sectoral research approaches if we are to tackle the complex issues mentioned in the Communication from the Commission such as:

- Coherence, connectivity and resilience of the Natura 2000 network.
- Conservation of habitats and species requires a wider environment favourable to biodiversity and cross-sectoral approaches (agriculture, forestry, water, marine etc).
- Biodiversity needs must be taken into account further upstream in the decision making process.
- Interactions between biodiversity loss and climate change adaptation and mitigation methods.
- A more coherent EU approach is required is required to reduce the loss of biodiversity globally, which ensures synergy between actions for governance, trade and development cooperation.
- A balance between development and conservation.
- The critical need to strengthen our understanding of biodiversity and ecosystem services, if we are to refine our policy purposes in the future.

Q2) What research infrastructures, data, science-policy interfaces, communication methods are going to be required in order to implement the work that needs to be done to meet these objectives?

Q3) Are these actions and objectives necessary and sufficient to enable us to halt the loss of biodiversity in Europe? Perhaps there are some fundamental research issues that we need to address if we want to look beyond 2010 towards a longer-term framework for future policy.

Days 15-17: In the concluding days of the E-conference we should also take some time to think outside of the box. If we do some distant horizon scanning will we see that we are missing some crucial bit of knowledge that doesn't fit comfortably into either the research or policy frameworks used above? If so we really need to hear from you.

What next? The results of the survey and of the electronic conference will be distributed to all respondents and will also feed into the12th meeting of the EPBRS to be held November 16-19 in Helsinki during the Finnish EU presidency. One of the key topics of the meeting will be the contribution of research towards and beyond the 2010 goal.

Survey of views on biodiversity research – a background paper for the EPBRS

Terry Parr, E-Conference Chair, CEH Lancaster, UK

As indicated earlier today, this session starts with a summary of current research priorities and their link to the 2010 target by presenting the results of the survey that has been developed jointly by European Platform for Biodiversity Research (EPBRS), ALTER-Net (A Network of Excellence on biodiversity Research) and the Finnish Environment Institute (SYKE). The full report of that study is attached to this contribution. The questionnaire forming the basis of the study was based on a comprehensive list of important research topics presented in the 'Message from Malahide' and the results represent the views of EPBRS members and participants in the biodiversity related networks of excellence, ERA-Nets and national biodiversity platforms.

The summary results from 27 questionnaires indicate that the three most important research recommendations are as follows:

1. Improve understanding of the major anthropogenic and natural drivers of biodiversity change, and their individual and combined impacts. Important drivers and pressures include (consisted from the original list), e.g. habitat fragmentation, climate change, pollution (including eutrophication), invasive organisms, loss of genetic diversity, sea- and land-use change.

2. Develop, test and evaluate indicators, and harmonise habitat and landscape classifications, to deliver policy-relevant information on the status and trends of biodiversity, the drivers of biodiversity change and the success of policies designed to halt the loss of biodiversity by 2010, and progress towards targets of the EC Biodiversity Strategy. Develop indicators of sustainable management of renewable resources, ecosystem integrity and ecosystem goods and services, vulnerability of livelihoods, public awareness and participation, and funding to biodiversity.

3. Further develop an accessible Europe-wide geo-referenced inventory of species and habitat distribution, status and trends, underpinned by significant new taxonomic effort, and support similar research in developing countries. This should include quantification of genetic diversity for species of economic or conservation importance, and improved understanding of traditional knowledge and uses of species and habitats.

Is this a fair reflection of the wider community and do they reflect policy priorities?

RE: Survey of views on biodiversity research – a background paper for the EPBRS

Greg Mikkelson, McGill School of Environment, Montreal, Canada

I would like to respond to the list of "major anthropogenic... drivers of biodiversity change" by observing that they are all 'proximate' causes. It is essential to understand the 'ultimate' causes as well, i.e., growth in human population size, per-capita consumption, and socio-economic inequality.

Research needs and challenges for the "systematic conservation planning" approach to the 2010 biodiversity target

Daniel Faith and Kristen Williams, Australian Museum, Sydney, Australia and CSIRO Sustainable Ecosystem Atherton, Australia

Among the highlighted research recommendations in the Introduction to the conference were those relating to understanding drivers of change and developing, testing and evaluating indicators. We note also that a key theme of this e-conference on the 2010 biodiversity target is "research influencing policy". It seems particularly appropriate then to consider the research needs arising from a proposed approach for meeting the 2010 target that is explicitly based on documented policy shifts in regional land-use planning. This "systematic conservation planning" strategy addresses overall biodiversity but integrates other needs of society. We'll argue that it raises important research issues relating to this integration.

The innovative approach, already being explored by Australian workers (Faith and Ferrier, 2005; Faith, 2005; Williams et al, 2006), proposes that take-up of "systematic conservation planning" (SCP) in a region can imply a shift to reduced rate of loss of biodiversity. It is based explicitly on the trade-offs and synergies made possible by SCP, and the expected gains from implementation of SCP relative to "business as usual". Biodiversity losses arising from society's pursuit of various non-conservation land-uses are reduced by SCPs trade-offs (e.g, through land-use choices among localities) and synergies (e.g., through improved uses within localities). Both aspects imply reduced conflict between biodiversity conservation and other land-use opportunities - and so also imply a reduced rate of biodiversity loss for a given rate of regional adoption of non-conservation land uses. It is noteworthy that not only clever spatial arrangement of conservation but also synergies are found through SCP – crediting, in some places, new or existing management regimes that serve both biodiversity and other uses in the same place.

Faith and Ferrier suggested that documented adoption of an SCP approach in a region could serve as a measurable indicator of the region's success in addressing 2010 – the resulting SCP processes would mean that the ongoing loss of land to non-conservation uses would now correspond to a lower rate of loss of biodiversity. The SCP approach in a given region would integrate the full range conservation instruments (e.g. payments to private land owners) and not be restricted to formal protected areas. Naturally, the approach takes into account the biodiversity status implied by existing land uses (and threats), particularly at places not affected by changes resulting from SCP-based planning.

A first case study: The challenge in practice is to identify the factors determining past and future losses of intact land – typically equivalent to opportunity costs of conservation – and then use SCP methods to implement plans that retain regional biodiversity in a way that accommodates these pressures. The Faith-Ferrier approach now has been explored in an initial case study, in Milne Bay Province, Papua New Guinea, that addresses some of these practical considerations (Williams et al, 2006; Faith et al, in prep). The study documents scenarios in which take-up of systematic conservation planning would lead to a reduced rate of loss of biodiversity.

A version of the Milne Bay Province, PNG, scenarios for 2010 is shown in the figure in the attached file. The dashed line is for SCP; the solid line is for the case where SCP is not used but several important sites for conservation of individual species within the region are protected; the dotted line is where non-conservation

opportunities are pursued in order of attractiveness, without regard to biodiversity conservation goals. The figure shows that, under SCP, the rate of biodiversity loss is reduced relative to the dotted line scenario. Implementation only of the set of (non-SCP) single-species important conservation areas produces only a shorter term reduction in rate of loss of biodiversity.

A strength of the Australian approach is that it addresses "overall biodiversity" through effective use of biotic (e.g. museum collections) and environmental data to form a best-possible surrogates "calculus".

The SCP approach illustrates the e-conference theme relating to "effects of research on biodiversity policy including examples of 'best practice'". But it also raises many research issues, and so may link to the e-conference interest in "three most important research topics for halting biodiversity decline and their justification".

We list below some key research issues that must be addressed in order to realize the potential that exists for the SCP strategy to provide a pathway for achieving the 2010 biodiversity target:

1) Improved estimators ("surrogates") for overall biodiversity are needed. Such approaches include making best-possible use of museum collections data and integrating such information with environmental layers. Other research includes the need to investigate whether a large-scale DNA barcoding programme would help overcome both taxonomic and geographic information barriers (see Faith (2005b).

2) Realistic estimates of opportunity costs of conservation, and their distribution, are needed, including ways to combine different costs.

3) Given that the SCP approach integrates and credits "partial protection" for biodiversity, arising from certain management regimes/ land uses, we need better estimates of those degrees of partial protection.

4) The SCP scenarios integrate information about rates of different kinds of land use change, but better models are needed for predicting such patterns of change in different places.

These research tasks, in the context of the trade-offs /synergies offered by SCP, would seem to go a long way towards the goal to "develop research practices and formulate research tasks in order to support the development and implementation of an effective and socially acceptable biodiversity policy." Such an approach would also provide the needed enhanced collaboration between researchers and policy-makers.

The Faith-Ferrier approach now has been explored in an initial case study, in Milne Bay Province, Papua New Guinea, that addresses some of these practical considerations (Williams et al, 2006; Faith et al, in prep). The study documents scenarios in which take-up of systematic conservation planning would lead to a reduced rate of loss of biodiversity.

A version of the Milne Bay Province, PNG, scenarios for 2010 is shown in Figure 1.

Figure 1. Milne Bay Province scenarios for 2010
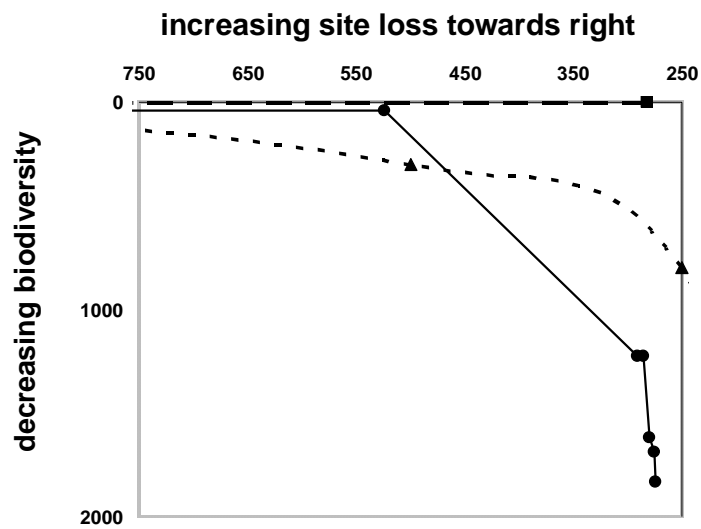
The dashed line is for SCP; the solid line is for the case where SCP is not used but several important sites for conservation of individual species within the region are protected; the dotted line is where non-conservation opportunities are pursued in order of attractiveness, without regard to biodiversity conservation goals. The figure shows that, under SCP, the rate of biodiversity loss is reduced relative to the dotted line scenario. Implementation only of the set of (non-SCP) single-species important conservation areas produces only a shorter term reduction in rate of loss of biodiversity.

What biodiversity?

Ferdinando Boero, Lecce University, Italy

I work on marine biodiversity and this contribution focuses on this. Our concern about the loss of species at a global scale is probably right for terrestrial habitats, but it is difficult to name one marine species that has become extinct. Picard made the list of the hydrozoans of the Mediterranean in 1958 and listed less than 200 species. Now the list has doubled. Apparently biodiversity increased! And the mediterranean is one of the most impacted seas of the planet. If they ask us for numbers (not based on estimates but on real data) we might come up with no numbers or, paradoxically, with greater numbers today than in the past. We continue to describe new species, and so we give the impression that the more we look the more we find. Only very few marine species are so well known that they cause concern if threatened. The majority of them is inconspicuous and if they disappear ... nobody cares.

I have a species of hydrozoan that has not being recorded since 1865 and, to me, this calls for some attention on its status. It is *Tricyclusa singularis* (by the way, it is the only representative of a family). So, if you ask me to name one species that has disappeared from the Mediterranean I say *Tricyclusa singularis*, but this does not impress many people. Even if I say that it is a whole family. It is probably better to focus at the habitat level, but this is less impacting, and there are no extinct habitats as far as I know.

Jaques Cousteau, 30 years ago, said that the Mediterranean Sea would be dead in 20 years. Cousteau died and the Mediterranean is still there. These messages can be very dangerous. I too am concerned about the loss of biodiversity, but I am also concerned about having strong arguments (and not only estimates). The "name one" question about extinct species in the sea is crucial. And one is not enough. One should ask if this one species would have died anyway. Species die, just like people. We know it from evolutionary biology.

In my opinion we have to use the information on species stored in the taxonomic literature and then we have to monitor the last record for each one of them. If they are absent from the literature for more than 100 years, then we should look for them. If we do not find them, then we can raise a case for extinction. Numbers would immediately become greater. And we have to identify places where biodiversity (in terms of both species and habitats) is more at risk.

An example: the Northern Adriatic is the coldest part of the Mediterranean Sea. It hosts species of boreal affinity that live only there, like Fucus virsoides (and Tricyclusa singularis). If there is global warming (and there is) what is the place in the Mediterranean that will be most affected? If the temperature rises, the cold water species go north or go deeper. In the northern Adriatic they cannot go north (there is the land) or deeper (it is a shallow basin). The communities of boreal affinity of the Northern Adriatic are probably the most sensitive to global warming. Let's make a list of the species that live just there (I gave two examples, but there are many more) and then let's see if they are still there. My bet is that they are in distress. We need data, and not estimates. These things can be done by taxonomists, because they know the history of the knowledge on biodiversity. Taxonomic literature is there to tell us when and where most species have been recorded.

I am not claiming that this is the only approach to this problem, but this is one of the many ways that we might run to foster our views while having real data.

RE: What biodiversity?

Franz Uiblein, Institute of Marine Research, Bergen, Norway

Thanks to Ferdinando for yet another very stimulating contribution. If we look at biodiversity change in the marine realm, by far the largest living space on earth, it is certainly good to take both the unknown and known into consideration.

Are threatening factors not becoming more and more evident through ongoing exploration and research? What about fisheries and pollution, including waste dumping? Certainly we do not fully understand all interrelationships (we don't even know all the species!), but aren't there indications that, for example, some fish species might be threatened at least locally by over fishing and that marine food webs (including human consumption) can be affected by pollution? Globally there may be no sign of biodiversity decrease so far, but locally I think there are potential threats that - admittedly - need to be studied in more detail. But as a first step, public awareness has to be raised in order to highlight why such studies are highly important. Who apart from scientists (including taxonomists) should do that?

I agree that the habitat level is important, but then immediately the question of scale arises as habitat is an operant definition with respect to the organisms that are unknown, studied, monitored, potentially threatened, locally extinct, etc.

RE: What biodiversity?

Rob Tinch, Environmental Futures Ltd.

Summary: Habitat-level and other non-species indicators may be more practically useful than evidence of extinctions.

This is very interesting. I think Dr Boero correctly identifies the problem, but I'm not sure focus on the taxonomic literature will provide much of a solution, not least because most knowledge about marine life is relatively recent. The fact that we can't point to specific extinctions presumably reflects lack of knowledge, not lack of extinctions? I think the "biodiversity has increased" argument should not directly cause too many communication problems: it is easy to explain that we're only now starting to find out everything that's there, and we still don't know what we've lost or are losing, and that biodiversity has not increased, we've just got better at finding it. However the argument that we don't know enough can itself be a problem ("go away and come back when you do know") - focusing at scales at which we do have reasonable knowledge (for example, status of habitats) may be a partial solution.

From the public communication perspective, I'm not surprised to hear that "*Tricyclusa singularis* is extinct" doesn't grab public attention. I suspect if you asked people to pick what it was (or had been):
(a) a dinosaur
(b) a 70s rock band
(c) a tropical disease
(d) an invisible sea creature
the answers might be pretty random (I'm not even going to start with *Fucus virsoides*). Why should anyone care?

Extinctions may be especially hard to prove in marine environments, we know relatively little about the implications, and the public knows a great deal less. Dr Boero suggests that it might be better to focus at the habitat level (I agree) but suggests that this is less impacting (I disagree), and that there are no extinct habitats (I don't think that matters). I think it is indeed more productive to move away from a species focus to look at features other than extinctions, especially where people can see that there is a clear implication for humans, or a clear feeling that "something's not right", and I think these can have high levels of impact. For example:
- Levels of ecosystem service (collapsed fish stocks, recruitment failures etc.)
- Genetic effects (reduced size at sexual maturity due to selective harvesting; gender balance/switching age in sequential hermaphrodites - I think people would react more strongly to clear evidence of this sort of human interference than to possible extinctions of unknown things)
- Populations of charismatic predators (sea birds, seals etc.)
- Habitat destruction (scallop-dredged sea grass beds, bleached coral etc. - before/after photographic evidence of this can be very powerful for communicating, and indicators are relatively easy to derive compared with species-level assessments)
- (Suspected) extirpations: even where extinction can't be demonstrated, extirpations might be; commercial extinctions can be easier still to establish. This might be enough for communication / policy purposes - e.g. there's a pretty clear message in saying the Irish Sea Skate is no longer to be found in the Irish Sea (I don't know if that's true or not, it could be a filthy rumour put about by elasmobranch-haters; it's just here to illustrate the point).

I don't believe these messages are unique to the marine environment, either. Similar points could apply to soil biodiversity in particular. But more generally images of damaged forest habitat, or measurements of reduced (value of) pollinator services, are probably more salient for both public and management than news that the lesser-spotted stamen-twitching beetle has (we think, but we're not sure) vanished from its range. Generally, I think our concept of species may not provide the most relevant measures of biodiversity from a communications or practical management perspective, except when we're dealing with large, charismatic animals (tigers, pandas, spotted owls, whales) or species we exploit directly. Beyond that, a service-level approach may be more useful (pollinators, bioturbators etc.)

The challenge is to make the science link diversity to service and on to communication indicators and management options. We might feel that species protection should be of primary importance, but in practice, demonstrating the importance of biodiversity to services, and showing what to do about it, is how we can win the policy battle.

Marine biodiversity loss - not just species

Keith Hiscock, Marine Biological Association, Plymouth, UK

Nando Boero correctly indicates that the "name one" challenge when referring to marine species extinctions may cause us to falter in the 'stop biodiversity loss' campaign. But, biodiversity is more than species - it is communities of species which often rely on structural features that are being destroyed by physical disturbance (especially bottom fishing gear and by land claim and coastal defences), it is genetic diversity which may be affected by local extinctions or disastrous declines in

populations, perhaps due to chemical contamination. Extinctions of marine species have no doubt occurred on a local scale - for instance during the period that TBT antifouling paint was used on small vessels, the species richness in the Crouch Estuary, eastern England, was half what it is today - and we do not know if any species were lost forever. There are also dangerous trends in the UK where policy advisors will major their advice on maintenance of 'function'. A damaged site is 'recovered' when it has regained biomass and function - so what do we have? We have bland species-poor communities that have producers and consumers and 'function', but the long-lived and slow growing species have been lost forever, or at least for a long time.

So, if we are going to fight against habitat homogenisation and the creation of 'bland' communities in the marine environment, we need to draw attention to the dangers of local extinctions and the decline in abundance of slow growing, poorly recruiting species.

Oh yes, and when I give lectures, I draw attention to the one marine species that I can think of that has definitely been made extinct in the North-east Atlantic by human activities: the great auk.

Name one habitat

Ferdinando Boero, Lecce University, Italy

I just promised to myself to stop writing, and here I am. Yes, Keith is right. Habitats are more evident than species as being subjected to impact. But, again, are there extinct habitats? And the fragmentation of habitats is said to lead to simpler communities and, thus, to lower biodiversity in terms of species occurrence. And here we are again with species. Sorry folks, we cannot avoid species when speaking of biodiversity. And one is not enough and, furthermore, the great Auk is not fully marine, since it used to reproduce on land. I am not saying that there are only species; I simply say that we cannot ignore the issue. As for Rob Tinch's comments on *Tricyclusa*, I am sorry but the red lists of endangered species on land are full of tiny insects that do not represent entire families. The lists of marine species are ridiculous. As are the lists of marine habitats in the habitat directive. Are we saying that some species are more important than others? In this case most of biodiversity is unimportant (most species are still unknown and most of the known ones are inconspicuous), so why worry?

What biodiversity? 'We need data, and not estimates???!!

Keith Rennolls, Greenwich University, UK

Fernando asks "What biodiversity", and suggests the magnitude of species extinction in marine environments may be much less than has been publicized for terrestrial environments. I wonder if he is looking through the darkened glasses, and does not see the real picture.

Fernando seems to be defining biodiversity as the common "species richness" index, i.e. the number of species in a population/environment. In his contribution he

says, amongst other things: "not based on estimates but on real data", "We need data, and not estimates", and "while having real data"

This position, that only "real data" is of value, and "estimates" are essentially worthless, betrays a lack of understanding of the effects of sampling of populations on the data that is collected. A big sample will obtain more species, as will a marine sample using a finer net. Hence raw data by itself really tells us little about what biodiversity is really there is in the sampled population. Estimation of unseen species, and hence estimates or population biodiversity, is essential if an unbiased view of biodiversity is to be attained. The raw data on species counts from samples will almost always miss the more rare species, and it is possible (likely?) that these rare species will be more susceptible to extinction when environments change, as the climate changes.

Biodiversity science needs estimation methodology to eliminate the distortions in "real data" introduced by sampling methods.

RE: What biodiversity

Ferdinando Boero, Lecce University, Italy

Keith asks us what we think. I concur with him that marine biodiversity is not adequately represented in almost all initiatives (from the Habitat Directive to Species 2000). Most actions are launched because of concern about the status of species, and not of habitat. That's why we speak about extinction (referring to species) but then if you say that *Tricyclusa singularis* is extinct even the people in this forum say: so what? And they are right. The perception of such things is zero.

Of course, if there are 1000 species like *Tricyclusa* then the story changes, but we are not looking for them. In other parts of this forum there are people that speak about the damage of trampling on some beetles (Carabids). So, the "don't stomp on roaches" message goes, but if it is in the sea, then nobody cares. Not even in the scientific community. Of course if we are not convinced, we cannot hope to convince politicians. So, terrestrial guys make their roach lists and have lots of attention, we do not. We have to work at all levels. The habitat level is the first, because it is operationally easy. Habitat mapping is possible, but we do not have complete maps of habitat distribution for the EU. There are maps of some parts of some countries, but the majority of the sea floor is unmapped.

Furthermore, there is no concordance on what to call habitat. There are lots of lists, but there are differences. Sometimes habitats are equal to communities (seagrass meadows) some other times they are geological features (mudflats). I know that there are habitat forming species, but we should reach some agreement on a list of habitats that is alright for the whole of the EU. In the habitat directive, the marine habitats are just nine, and only two apply to the most biodiverse sea of Europe: the Mediterranean.

To me biodiversity is just as described in the Rio convention: habitats, species, and genes. And one level cannot convey information without the others. My strategy, thus, should be to make a list of EU marine habitat types (now there are too many lists) and propose that we have to map them, at least from the surface to 30 m (oceanographers like to go offshore, marine biologists like the intertidal, very often we know nothing about the coastal subtidal, where our impacts are higher). This will tell us about the points of biogeographic discontinuity in a more precise way,

identifying basins with homogenous features, and we will know about "rare" habitats, and habitat hot spots. Then, with the aid of taxonomists, I would like to have a list of species for each habitat. Taxonomic work tells us about the records of the species and about where they have been found. If we take ERMS and put its habitat type(s) near each species, then we have, for each habitat, the list of the species that occur there. Some will occur in many, some will occur just in one. At this point we'll have the species diversity of each habitat, and that list will be some sort of hypothesis. If there is a habitat, I expect to find species that are in that list, and the more I find, the higher is the diversity of that habitat. If I have that list, I also know the list of the species that I did not find. That's the way the *Tricyclusa singularis* come out. We always list what we find and not what we do not find.

We speak about extinction, but we study occurrence. And we do not care about the species that do not occur. A very strange logic. I have read the document we are commenting on. The word taxonomy does not appear. I do not say that biodiversity is taxonomy, but I dare to say that biodiversity without taxonomy smells funny.

Mathematics and the real world

Ferdinando Boero, Lecce University, Italy

Mathematical modelling without relevant data is hot air. The failure of fisheries management stems just from this attitude: the lack of understanding that the world out there is not equal to what you stuffed into your computer. Beautiful models, lousy data, no more fish. Just as with economics. Thanks for your estimates, but I do not buy them without proper data. The reason is that the variables to consider for such exercises are many and are not tractable due to their number. The magic word is relevance. And models are often based on lack of understanding of what are the relevant variables to put in the model. Mathematics is essential, but it cannot replace the real world, in spite of what mathematicians think. I know very well about sampling procedures, and I know that there are estimates to be done, but if we make beautiful estimates about extinction and then we do not care about listing at least one extinct species, and we are not even interested to see if it exist(ed), then our credibility will be very low. Mathematics (with all its beautiful estimates) is not enough. Just as natural history is not enough. I am not saying that what I propose is the optimal strategy, I say it is one worth considering. If you say that estimates are sufficient and we can skip species diversity, then I am not with you. And that's why taxonomy is disappearing in the era of biodiversity. In another contribution I state, of course, that biodiversity covers the levels of habitat (or ecosystem), species, genes, just as written in the Rio Convention, and stressed very well by Carlo Heip. Species are there, I am sorry.

It is not "just" species diversity, but species diversity is important. And if we speak about extinction, then we speak about species. And I would like to see some species in these exercises on extinction, because when the "name one" question is posed I think it is not enough to come out with estimates. Not wanting data is a very strange attitude indeed, especially when shown that they are out there and we have only to get them. But we cannot get them while sitting in front of our computers. I know that real data are distortions for modellers (the non-existence of any proof of

extinction in the sea is a distortion linked to sampling, if we could sample in a better way we would find it. It reminds me about religion) and that estimates are cleaner. I once heard a physical oceanographer saying that his model of the ocean was alright, it was the Atlantic Ocean that behaved in a strange way. And he was serious. Let's be really serious! And let's start to collaborate. Estimates tell us something, very good. There are extinctions, terrible ones. Now we have the message. Now I would like to document them. In another message I refer to how to do it.

RE: Mathematics and the real world

Syed Mahmood Nasir, Quaid-i-Azam University, Pakistan

The scientific (pragmatic) debates on loss of biological diversity appear to be based on the notion that our knowledge of the phenomena and processes of nature are very advanced; however there is a caveat: we believe that the current pragmatic knowledge is perfect while this is not so. Very little of the diversity of life is known. For example only 26 percent of mammals, 13 percent of flowering plants, less than 4 percent of bacterial life (and so on). What should be kept in mind is that we are talking about strategies and global targets for conserving the unknown!

Are we sure that in this endeavour we may not lose much of the unknown at the cost of the known? The problem is exacerbated by the recent developments in theory that the idea of nature achieving a harmonious balance may be wrong and that chaotic disturbances are normal.

Another issue in this complex debate is that (we) the positivists pay less or no attention to the social sciences (political ecology in particular)- rather their role is restricted to Articles 8 (j) and 15. Max Weber's methods of Causality, Ideal types etc did not draw the attention they deserved due to the overwhelming stature of Karl Marx. What I mean is that there is a danger in representation of truth while modelling empirical science or is it what social science would call the social representation of truth?

RE: Mathematics and the real world

Keith Rennolls, Greenwich University, UK

Syed Mahmood Nasir makes the following important point: "Very little of the diversity of life is known. For example only 26 percent of mammals, 13 percent of flowering plants, less than 4 percent of bacterial life (and so on). What should be kept in mind is that we are talking about strategies and global targets for conserving the unknown!"

It follows that estimates of the unknown, and how they may be affected by conservation efforts (or their absence) are crucially important. Estimates of the unknown have to be based on the observed data, but use of suitable biodiversity modelling methods is essential.

Broadening the discussion of research needs

Mikael Hildén and Eeva Furman, Finnish Environment Institute SYKE

The Commission's communication on Biodiversity lists four key policy areas with ten priority objectives and four groups of measures. There is nothing surprising or new in the list of objectives, which could be interpreted to mean that we simply need to do more along the same lines as hitherto. This is also the message that emerges from a survey of key European biodiversity researchers and managers on biodiversity research carried out in 2006. With this framing of the problem the communication can be interpreted as a recipe for simple action: Put more money into conservation; educate decision makers in biodiversity, find links between different biodiversity efforts and make the public understand biodiversity.

All of this could be achieved by doing more standard research on biodiversity, combined with research dissemination. But does this fit with the urgency of the problem and the countdown to 2010? In his plenary lecture at the 1st European Congress of Conservation Biology in Hungary August 2006 Sir John Lawton claimed that "conservation is not about science" but about policy and politics. What does this alternative framing of the problem mean for biodiversity research? It can cause frustration and a feeling that ever more lobbying is needed for traditional biodiversity research. This is a classical reaction in which one expects radical change in society, while assuming that incremental changes in one's own work are sufficient. In most cases this leads to even greater frustrations.

Alternatively one can radically reassess research needs, accepting that societies are only willing to change incrementally. This changes thinking on several levels. First, the depth of knowledge should match policy needs. For example, the basic mechanisms of present biodiversity loss are sufficiently known for policy purposes, but there is much less understanding of how one can develop measures for safeguarding biodiversity that gain wide acceptance without excessively straining state budgets. Second, the survey showed that there is a lack of understanding of how science can contribute to policy and policy implementation, except by providing normative statements on the need for biodiversity protection. Research into relevant processes is needed to develop understanding of decision-making or problems of public education. Third, there is a need to experiment with incentives that turn awareness into action for biodiversity. One should study how people can use what they know already to protect biodiversity rather than assume that people must know even more before they can do something.

This rethinking implies that the discussion on research needs should be broadened considerably from the biodiversity community. To paraphrase Georges Clemenceau: Biodiversity is much too serious a matter to entrust to biodiversity experts.

Defining the target

Bill Kunin, Leeds University, UK

It seems to me that the first topic that needs to be discussed before we can decide how to reach the 2010 target is: "how should the target be defined?"

(a) On one hand, if we mean no NET loss of biodiversity, the target may be achievable, but we may not want it. As Rosenzweig pointed out, the gradual breakdown of biogeographic barriers probably means an INCREASE in regional diversity in most places, while still threatening a loss in global biodiversity. Europe will probably gain more alien species than it loses by the extinction of endemic species, but my guess is that most of us would not deem that a success.

(b) A second version of the target is no global extinction of any European native species. This is probably not achievable, but makes a worthy aspiration. One problem here is the lack of information: even in a well-studied place like Europe, we don't really know what biodiversity we have, as much of the richness lies in regions and taxonomic groups that are poorly studied. Another concern with this version of the target is that it does not count as a "loss" any regional extinctions. Thus, for example, most British rarities could be lost without affecting the target, as most are much commoner somewhere else in Europe. As a consequence, this formulation of the target would suggest that each nation place great emphasis on national endemics in conservation planning.

(c) A somewhat more ambitious goal would be to prevent the loss of any native species from any region (nation-state?) in Europe. This would satisfy the concern raised above, but at the expense of making the target demonstrably unachievable. In the face of environmental change, it is inevitable that species will shift their ranges, and taking on a commitment to prevent such shifts seems to me to be standing in the face of the advancing tide (ala King Knute). What do the rest of you think? Are there other alternative readings of the target? Of the available options, which should be our goal, and the focus of our discussions here?

RE: Defining the target

Lars Berg, Swedish National Scientific Council on Biological Diversity, Sweden

Your question is very important, but it would not help the current discussion to enter into definitions. At the political level, i e where the 2010 target matters, the definitions are being worked out in terms of 2010 target indicators. The European context is the SEBI 2010 project coordinated by the EEA.

We should not expect these indicators to tell us whether we have "really" managed to halt biodiversity loss by 2010. But given that politicians have set an ill-defined target, definitions will not help us solve the problem of how to monitor its fulfilment.

What should concern us more is how to provide a sound basis for the formulation of future targets that can actually be monitored. If not at the next EPBRS meeting, this is a subject that will need to be discussed very soon, so as to contribute to the discussions foreseen in the Commission communication as well as the global debate within the Convention on biological diversity.

Aiming at the target: building on existing tools

Michiel WallisDeVries, De Vlinderstichting - Dutch Butterfly Conservation, Wageningen, The Netherlands

If we really want to have an impact as conservation biologists, we should work with the tools that make sense to politicians. To start with, I would consider the following pragmatic steps:

- Taking Natura 2000 as a baseline for the protected areas network. The main answers to be found here are: 1) will Natura 2000 - if effectively implemented - adequately protect the biodiversity that it is meant to protect? 2) If not, where are the main weaknesses that need to be addressed? 3) To what extent can Natura 2000 accommodate expected climatic changes with resulting shifts in species' ranges?

- Measuring changes in biodiversity: take the habitats and species listed in the Bird and Habitat Directives as starting points, and designate the characteristic species for Annex I habitats. Evaluate to what extent an assessment of population status and trends is feasible for these species (this is being explored in the EUMON project). Take a selection of indicator species to address the above-mentioned questions.

- Review the options for a) increasing connectivity and 2) improving habitat quality. This includes an evidence-based review of current management practices in conservation biology. The idea to develop a network to enhance evidence-based conservation reviews was discussed at the recent European Congress of Conservation Biology in Hungary. Gaps that emerge from these reviews may be used to formulate the research agenda to support the implementation of conservation measures.

RE: Aiming at the target: building on existing tools

Keith Hiscock, Marine Biological Association, Plymouth, UK

Yes, we should build on existing tools. But the Habitats Directive was developed at a time when the tools for identifying threatened marine habitats and species were poorly developed and the Directive has been difficult to apply in the marine environment. Nevertheless, many of the sites (in the UK at least) are good. Trouble is that public money is being spent on implementing flawed parts of the Directive (especially offshore in the UK) when it would be better spent addressing real issues of threat in the marine environment.

My thoughts were expressed at the recent meeting of the 1st European Congress of Conservation Biology in Eger, Hungary and (local to the UK) in a presentation to our Biodiversity Partnership. Both presentations can be seen (and heard in the case of the Eger one) on www.marlin.ac.uk/pap/index.php?presentations.

What do you think? - If we are to act in a positive way to protect marine biodiversity - does the Habitats Directive need revision or 'kicking into touch' (i.e. removing from play)?

Target and vision

Barbara Livoreil, SOPTOM, France

This may be a very simple contribution, but strongly based on my daily experience with local politics and stakeholders. The 2010 target is about halting the decline of biodiversity. Let's take this even further. In an ideal world, we would aim at one single thing: Earth as a big hotspot of biodiversity. Now back to reality, we have fragmentation, habitat loss or change, and disappearance of individuals within species. Lawton is right because conservation is primarily a matter of vision and human's desire. What kind of planet do we want, given that we are aware of being one of the most powerful species there?

IUCN helps us in deciding what the target is, using the Red List. Because if we want to save biodiversity, priority should first be given to the most endangered species. Then to vulnerable ones and so on. It also tells us what to measure: abundance, viability, area of distribution, genetic integrity and variability.

So when alien species invade Europe, it is bad only if there are common species (which often they are) and if they cause the decline of native ones (scientists need to measure that and provide evidence!). But if because of climate change for instance we suddenly have some tropical fishes arriving along our shores, or exotic birds, what do we say? If some of our native species move up north to keep on meeting their habitat requirements, is it a loss? Not to me, if they keep on maintaining viable populations (which means the habitat is fine, threats are low...)

To me habitat loss in itself (in terms of space, merely), and loss of habitat quality, are the two more important targets. Do we want to share the planet with other living beings, apart from domestic ones and pests? Is wilderness one of our values?

Preserving habitats means either to create reserves, or to create incentives to push landowners to manage their land in agreement with biodiversity requirements (with priority to the most endangered species). This is first of all politics and economics, because deciding the creation of a reserve, or designing new laws, is their work. Scientists help in the design and in the management (monitoring, measuring efficiency of conservation actions...). Scientists can also be of a great help to counterbalance decisions based on beliefs or personal interests, by providing a method to answer questions (from politics, many examples how should we do this...what will be the consequence of doing that...) as sustainably as possible (thanks to statistics and scientific protocol) and also to design hypothesis (alternative hypothesis and statistics). Finally, as for climate change or new diseases, scientists must keep on ringing the alarm bell, and improve the way they communicate to public and politics to be heard more efficiently. Finally again, scientists must fight for sciences, because too often people see it as useless, synonymous with complexity, jargon, and upper thousands (elites). And this will serve everything, and biodiversity too!

Do we have any indicator measuring the surface of land that is saved for wildlife, and see how it evolves? Another one for land where wildlife is protected and human activity allowed, and see how it evolves? A third one of very bad areas for biodiversity (some threshold-proportion of houses per square meter for instance) and see how they increase? I am quite sure someone must have thought of this before me!

Laura Airoldi, University of Bologna, Italy

This contribution aims to provide some background information about the historical losses, drivers of change and current status of coastal marine habitats of Europe. This knowledge seems critical for identifying future directions in the sustainable conservation and management of Europe's native coastal habitats and species.

The following information and ideas are from a review that myself and Mike Beck have recently completed, and that we presented at the recent 1st European Conservation Biology Symposium in Eger (Hungary) as well as to the Conference of the Italian Ecological Society centred on "Global changes, biodiversity and sustainability".

European estuaries and coastal areas have a long history of intense human colonization, impact and urbanization and are among the most severely degraded coastal temperate systems worldwide. Over the centuries, land reclamation, coastal development, over-fishing and pollution have nearly eliminated European wetlands, seagrass meadows, shellfish beds, biogenic reefs and other productive and diverse coastal habitats. It is estimated that every day between 1960 and 1995, a kilometre of European coastline was developed. Most countries have estimated losses of coastal wetlands and seagrasses exceeding 50% of original area with peaks above 80% for many regions. Conspicuous declines, sometimes to virtual local disappearance of kelps and other complex macroalgae have been observed in several countries. Most habitat loss estimates refer to a relatively short time span primarily within the last century. However, in some regions, most estuarine and nearshore coastal habitats were already severely degraded or driven to virtual extinction well before 1900. The native *Ostrea edulis* reefs, an extremely valuable and highly diverse habitat, which supported a productive commercial fishery for centuries, were commercially extinct by late 19th century and ecologically (to entirely) extinct by the 1950s along most European coastal regions and in many bays well before that.

A few dominant threats have led to these losses over time. The greatest impacts to wetlands have consistently been land claim and coastal development. The greatest impacts to seagrasses and macroalgae are presently associated with degraded water quality while in the past there have been more effects from destructive fishing and diseases. Coastal development remains an important threat to seagrasses. For biogenic habitats, some of the greatest impacts have been from destructive fishing and over- exploitation with additional impacts of disease, particularly to native oysters. Coastal development and defence have had the greatest known impacts on soft sediment habitats with a high likelihood that trawling has affected vast areas.

Nowadays less than 15% of the European coastline is considered in 'good' condition. Those fragments of native habitats that remain are still a focal point for human colonization and use, and the benefits of policies and directives aimed at reducing and reversing these losses have been so far low. We have suggested some key needs and opportunities for enhancing the overall conservation and management of coastal and marine habitats in Europe including:

1) Currently, there is no comprehensive summary of the distribution of habitats along European coastlines and their management does not seem to be well informed by adequate knowledge of their status and historical trends. Detailed habitat mapping should be given high priority to promote conservation and sustainable

management practices. Developing a consistent habitat classification (i.e. European Union Nature Information System) is also a necessary precursor

2) These habitat distributions then need to be compared with the existing protected areas to identify gaps in protection. To fill these gaps, there should be systematic planning for placement of new protected areas and other management measures.

3) The values of these coastal habitats also need to be better assessed to provide real estimates of the ecosystem services that they provide such as pollution regulation, storm hazard reduction, productivity of nurseries for fisheries, and recreation. Better valuations of these services will illustrate for communities and governments the real costs of this habitat loss and should provide impetus and economic incentives for their protection and restoration.

4) Management goals for these habitats should be based on historical estimates of the distributions of these habitats, not the vastly reduced current distributions. Even extremely modest goals of 10% protection of the historical distributions of European coastal habitats may require some restoration for many habitats

5) To meet goals for conservation and restoration there should be greater involvement by nongovernmental organizations and community groups and there are tools that they can use to contribute directly to conservation and management. There are also new tools, such as the private leasing and ownership of marine lands and resources that can be employed more often by private groups to help protect and restore coastal habitats

6) The EU and member nations have been dedicated to developing better Integrated Coastal Zone Management (ICZM) for some time. The development of strong and effective ICZM programs has been slow for most nations. These programs need to advance further to slow and reverse coastal habitat loss.

7) There is much interest in developing a more ecosystem-based management (E-BM) approach for managing the many marine resources and the overlapping stakeholder needs. E-BM has been incorporated as a central goal of the EU's emerging 'Marine Strategy'. While this approach is needed and sensible, it will take many years to develop and its development should not be allowed to slow efforts to protect and restore habitats now.

Scale mismatches in biodiversity research

Thomas Dirnböck, Umweltbundesamt – Federal Environment Agency, Austria

I would like to raise a particular issue, which is pivotal to all three research recommendations (improve understanding of the major anthropogenic and natural drivers of biodiversity change; development of indicators; European wide inventory).

My point of departure is that research which is relevant to policy and efficient in managing biodiversity can best (or only?) be achieved by interdisciplinary groups from a wide array of fields (biologists, ecologists, social, political and economic scientists, etc.), and the participation of the wider public (in particular those being exposed to local biodiversity management). Many of the former contributors indirectly or directly support this view as well.

One particular challenge within the endeavour of interdisciplinary biodiversity research is the issue of temporal and spatial scale and the level of organization. Ecological and social processes operate at a wide variety of scales or levels and cross-scale/level interactions occur frequently. Integrated research needs therefore to be conducted at appropriate scales and levels so that efficient and goal-oriented political and management decisions can be taken at all appropriate scales and levels. Mismatches between the scale of environmental management and the scale(s) of the ecological processes being managed as well as the disregarding of actions at particular scales have been identified as a major caveat in nature conservation (e.g. by the Millennium Ecosystem Assessment).

An interdisciplinary working group from within the EU FP6 Network of Excellence ALTER-Net did assess a series of biodiversity research studies (from 5 European countries) with regard to the treatment of spatial and temporal scale. The main objective was to provide recommendations for the design of new-generation European LTSER (Long-Term Socio-Ecological Research) platforms. The LTSER network should, in the future, provide infrastructure for integrated research and monitoring which is efficient in addressing policy relevant biodiversity issues. The case study assessment highlights several problematic issues of contemporary interdisciplinary biodiversity research:

A) The assessment of the case studies showed that scale mismatches are both a question of failure and of neglect. The majority of studies did address some scales but did neglect others. Often the focus is on one end of the scale range. For example, the landscape scale processes of plant or animal populations are often neglected when the focus is on local scale dynamics. In these cases the scales of management and biodiversity-relevant policies are neglected too as they are expressed at the landscape and broader scales. It seems to be a commonality to ignore or to wrongly address the variety of scales biodiversity-relevant policies are implemented.

B) Long-term biodiversity research is still very rare so that the relevant scales of management and of policies are often not addressed. We see the mismatch of long-term processes, typical for both, the biogeophysical and the social system, and short-term studies as a major caveat to better manage biodiversity.

C) The case studies highlight that scientific support (e.g. the development of indicators, adaptive social and ecological monitoring, system behaviour analysis, etc.) is particularly limited for biodiversity-relevant policies and, but to a lesser extent, for management due to the neglect of relevant scales.

D) Research on cross-scale interactions – where processes and phenomena at one scale or level influence processes and phenomena at other scales or levels – of socio-ecological systems is very limited.

The ideal case of a strategic and long-term integrated research project tackling all relevant scales an levels of biodiversity (including the biogeophysical system, its management and the biodiversity-relevant policies, their goals and targets) rarely takes place. The case studies surveyed exemplify characteristic scale mismatches, neglects of one or the other relevant scales and levels, and the superficial consideration of cross-scale/level interactions.

We have to admit that policy-relevant interdisciplinary biodiversity research is in its infancy. However, there might be remedies in order to develop interdisciplinary research which is much more policy-relevant than what has been done in the past. Long-term funding and long-term research infrastructure could darn the mismatch between short-term studies incapable to provide information on long-term system dynamics. The disciplinary focus in education and research should be broadened in order to allow for the development of useful interfaces to other disciplines. And the support of interdisciplinary biodiversity research would allow for further development of appropriate interdisciplinary theories, methods and expertise.

The case study assessment was carried out and the results were discussed by Bezák, P. (SK), Dullinger, S. (A), Haberl, H. (A), Lotze-Campen, H. (GE), Mirtl, M. (A), Peterseil, J. (A), Redpath, S. (UK), Singh, S. (A), Travis, J. (UK), Wijdeven, S. (NL), and Dirnböck, Th. (A).

Understanding drivers of biodiversity change – developing effective responses

Anke Fischer, Macaulay Land Use Research Institute, Aberdeen, UK

The EC communication emphasises in its introductory sections the role human behaviour has been playing in influencing biodiversity change (EC 2006). Many drivers of biodiversity loss are raised: the human desire for development, human lifestyles, increasing consumption rates, population growth, governance and market failures. The communication then speaks of 'actions', or policy responses, and lists key policy areas and priority objectives. The vast majority of these are biodiversity-centric and focus on desired outcomes for biological diversity – hardly any of the objectives elaborate on the human-related factors mentioned above, but treat them, at best, in a rather superficial way.

However, what are the precursors to these actions that may halt biodiversity loss? Sociological, institutional and psychological research provides a wealth of insights into the origins of human actions – understood here as purposeful and conscious behaviour (Aebli 1980) - and behaviour in general. Undoubtedly, taking targeted action to halt biodiversity loss requires ecological expertise in the widest sense, and policy documents such as the EC communication consequently emphasise these ecological aspects. But as it is well known, knowledge about the natural environment does not necessarily lead to environmentally-friendly behaviour (Kuckartz 1998; Diekmann & Preisendoerfer 2001). To an even lesser degree will knowledge held by a scientific and policy elite lead to behavioural changes of the entire public.

I argue that our understanding and awareness of the factors that determine human behaviour related to biodiversity is still very poor, although considerable progress has been made during the last ten years. For example, research has shown how people's views on wildlife, nature and landscapes is part of their lives and lifestyles (Skogen 2001, Buijs et al. 2006a), how their perception of risk and threats associated to biodiversity loss together with the perceived effectiveness of interventions relate to their willingness to take action (Menzel 2004), and how the concepts of social identity and reactance can help explain actors' behaviour with regard to protected areas (Stoll-Kleemann 2001). Numerous other examples could be mentioned, and not only single researchers but also networks such as ALTER-Net have been incorporating socio-economic drivers of biodiversity change and public attitudes in their agendas, showing, for example, how people's concepts of biodiversity and their normative implications are related to their attitudes towards biodiversity management (Buijs et al. 2006b). However, many questions remain, of which I would like to mention just one: What are the factors that determine whether members of the public actively support, accept, ignore or disapprove of particular policies and management measures? An integration of institutional, psychological and sociological approaches could help us here to see the bigger picture.

We thus need more social scientific research into the issues behind biodiversity change. Maybe even more importantly, however, the progress that has been made is still not incorporated into the mainstream discourse on conservation and natural resource management issues. Although the EPBRS Killarney recommendations now include sociological and psychological research as one of their priorities (EPBRS 2004), much needs still to be done, as it is essential that we understand the factors that constitute drivers of biodiversity loss in order to develop effective policy responses.

Social science research needs for conserving/restoring EU biodiversity and enhancing coordination with development policies

Rob Tinch, Environmental Futures Ltd

This contribution aims to stimulate debate on the social science research needs for conservation policy, and on how to integrate these within a coherent programme of interdisciplinary research.

Research is leading to increasing awareness of ecosystem services, factors driving them, and their value to humans. Major initiatives include e.g. Nature Valuation and Financing Network and Ecosystem Services Database. Recent reviews cover e.g. the value of ecosystem services (Eftec 2005) and ways of taking values into account (Eftec and Environmental Futures 2006). Work in specific sectors demonstrates benefits of the service/value approach, e.g. Emerson and Bos (2004) conclude: "Under-investment in ecosystems results in reduced water services" and "Including ecosystem values in economic analysis improves decision-making". Ongoing research includes e.g. RUBICODE, which explores how applying concepts of service providing units in dynamic ecosystems can enhance understanding of service drivers and values and improve management potential.

The services/value concept can enhance coordination between conservation and development because:
- Consequences of lost services can be weighed against benefits of development
- Potential for services to substitute for development can be considered

For example UK flood defence increasingly recognises that natural systems can offer better, more cost-effective and/or more sustainable protection than "hard" defences. Nevertheless, a major barrier remains the lack of accepted values/approaches for including specific habitats and services in appraisals.

Two essential tasks are establishing how biodiversity supports ecosystem services and making this knowledge management-relevant. Social science must contribute to interdisciplinary research to support these tasks, for example:

(A) Understand how changing conditions (climatic, socio-economic) influence not only ecosystems directly, but also human demands on systems, services obtained, and values of those services. "Future proofing" must be considered in terms of overall sustainability and resilience of ecological-economic systems which recognise human activities, and their dynamics, as integral.

(B) Research into indicators and decision-support tools to translate knowledge on ecosystem services into useful measures for decision-makers. Answers depend on decision makers, legal/institutional constraints, and relationships with other stakeholders. Research topics include: better methods of presenting and managing uncertainty; benefits transfer and aggregation issues; relative merits of (and synergies between) discursive and monetary valuation methods.

(C) Increasing reliance on stakeholders for legitimising management means research is needed into better incorporating stakeholder input in appraisal methods, including better consideration of winners and losers, and conflict resolution methods

(D) Management requires policies to alter human behaviour (through negotiation, moral argument, legal restrictions, fees/taxes, incentives, information/technology exchange….) Different policies generate different responses: further work is needed on how people and firms respond to different instruments, and on how this interacts dynamically with ecosystem process and services.

Conserving and restoring biodiversity and ecosystem services in the wider EU marine environment

Carlo Heip, Netherlands Institute of Ecology, The Netherlands

Conservation and restoration of marine biodiversity requires research on the effects of local disturbance, fisheries and global climate change at the appropriate scales in order to understand resilience and adaptability of marine populations and communities.

A large part of the European Union is under (sea) water and much of that is under some kind of national jurisdiction. Many national programmes of marine research and many national and EU coordinated projects have delivered a lot of information on pollutants, eutrophication, coastal morphodynamics etc in relation to land-ocean interactions, coastal zone management and the EU common fisheries and agricultural policy. But few projects have addressed the basic issues of inventories of biodiversity at the national and even less the European scale. Those inventories that exist are mostly local and far from covering biodiversity at the three levels, genes, species and ecosystems. Moreover, only a few really long-term time series exist, mostly in the vicinity of marine biological stations and there is no policy for maintaining the ones that exist, let alone creating new ones that would cover the European seas more exhaustively. For collecting the basic information on what biodiversity exists when and where, a European policy for biodiversity observation is an absolute necessity, if only to establish the baseline from which we can follow and measure the changes in biodiversity.

The conservation and restoration of marine biodiversity requires more than that. Basic understanding of the processes governing creation and maintenance of biodiversity is still lacking, including dispersal, gene flow etc. Fisheries, pelagic and demersal, and global climate change are the main drivers of biodiversity changes in the oceans. The effects of increasing water temperatures have already been demonstrated, for instance through the Continuous Plankton Recorder surveys and through data from the fisheries. A few coastal time series exist from which such distribution shifts can be followed and in all these cases an important northward shift of species has been demonstrated. What the consequences are for biological communities, as created by species interactions, is hardly known. In how far species can adapt to rising temperatures and to new species arriving, what selective pressures will become important, how species will evolve and so on can only be studied through experimental setups in conditions sufficiently resembling the natural environment, e.g. in mesocosms. Knowledge on the resilience of coastal communities is important, for instance in view of the rapid increase in invading species or increased tourism. What size and where to situate a marine protected area, what kind of disturbance is allowed, do we need marine natural reserves besides protected areas, etc.

RE: Research requirements for marine biodiversity

Michael Thorndyke, Kristineberg Marine Research Station, Sweden

There are many key points here one of the most vital being the establishment of a European policy for biodiversity observation and experiment. Criteria must surely include:

1. Identification of currently available long-term time series inventories and making that data available and harmonized with other more current data. The BioMare project has gone someway towards this and the identification of potential sites of course.

2. If this can be coordinated with the selection of MPAs that is currently taking place then we are going in the right direction especially if that can also be tied in with either existing or potential reserves then we are on the way.

3. As pointed out, assessment, conservation and restoration is only part of the answer. Inventories are only "snapshots" and this is why 1 and 2 above are important to be coordinated so we can have a series of snapshots and end up with a "movie" of changes and developments for as long a period as we can manage. Obviously the movie's running time will depend on length of time series.

4. Where are the "gaps", where do we lack data?

5. Similarly as noted in the previous mailing we need to be able to predict what the movies of the future might look like and the only way to do that is by experiment and testing the adaptive potential of both individual keystone species as well as at the mesocosm level suggested. We certainly have many of the tools available now, including sophisticated molecular tools but in the end we need to know how the phenotype can/will adapt. Such experiments are not trivial and to be of use should be multifactorial. This for certain needs a coordinated European effort.

Biosphere reserves, inventories and education

Dieter Armerding, Österreichisches Orchideen Netzwerk (ÖON), Austria

I couldn't agree more with every one of the points Michael made. Point Nr.3 in particular is quite important. Conservation may lead to better botanical or zoological gardens, which I like. But there is no future in this. We do need to live in this world. This is why I originally liked the UNESCO Biosphere concept. I cooperated in creating the Biosphere-Park Vienna Woods, because I live there. But when you give this a closer look this will only create small islands mostly in rather exotic and remote parts of the world. What we need is to integrate the majority of people living in Europe in an ecologically intact environment, which includes Nature as the most important part of our living world. The target is Planet Earth as our Biosphere. And yes, this requires a more coordinated European effort and a lot of financing.

As far as doing inventories are concerned: It's necessary but we don't want get stuck with snapshots. This is why I decided to get involved in biodiversity monitoring. Being short of money, Austria decided to do only indicator-oriented monitoring, which is better than nothing but not enough. However, for obtaining useful results until 2010 this will certainly be irrelevant - more a symbolic act. Monitoring should be a continuous process and it should also be associated with definite, legal and effective measures to do something against trends of species extinction.

We also need more people like Edward Wilson or others he inspired. Our future natural world will not be improved by scientists only. We have to teach our children environmental ethics, the necessity to rescue ecosystems rather than single species, the importance of alternative goals in our lives and responsibility for the future!

RE: Biosphere reserves, inventories and education

Douglas Bardsley, Department of Water, Land and Biodiversity Conservation, USA

I have enjoyed reading through the submissions to the debate. I believe the discussion is very important to understanding how the political will could be generated to support the conservation of biodiversity in the EU. Important points are raised that the community can largely be disinterested in biodiversity conservation, have divergently different views of its importance from ecologists, or be actively working to reduce/degrade it. To respond to the challenge of divergent views from a concept of ecological sustainability, I agree with the point made by Dr. Dieter Armerding that "What we need is to integrate the majority of people living in Europe in an ecologically intact environment which includes Nature as the most important part of our living world". To achieve such a goal it will be vital that ecologists understand other people's views, even as they might disagree with them, to develop and present arguments for a comprehensive approach for ecological outcomes that are both socially and environmentally effective. Otherwise, the best ecology can be lost on the way to the shop!
I have been working on such interdisciplinary conservation issues in Europe, both in relation to invasive species management and agro-biodiversity, and in an Australian region with a Mediterranean climatic-system in relation to conservation in an era of climate change.

Biodiversity in danger and scientific duty

Jean-Pierre Féral, Centre d'Océanologie de Marseille, Station Marine d'Endoume, France

Let us consider the deadline of 2010. All countries are preparing this day. Excellent ideas are developing. But what about their realization? What about effectiveness? Do we make superb theoretical constructions, or do we actually take the future in our hands? Do we speak, or do we throw up our arms helplessly? To claim more policy is certainly a good way, so that things are not made anyhow. But that takes time and the passing of time is surely the worst enemy of biodiversity. The passing time leaves the field free for the most noxious and irreversible decisions.

It is probable that many readers of this forum know the critical situation of the Marine Station of Endoume (MSE), in Marseilles. For pretexts which are oblivious of reason as well as science, this laboratory which is devoted to the study and the protection of the marine biodiversity seems condemned to disappear. The research unit which occupies the MSE will be obliged to move to a campus in the middle of the garigue, 14 km far from Endoume. No more access to the sea. No more facilities of running sea water experimentation, in spite of the importance of this type of study.

The daily newspaper "Le Figaro" that is close to the opinion of the current French government very recently published an article on the programmed closing of one of the four "large" marine laboratories of the coasts of France, the "Station Marine d'Endoume". This article is online on the site of the newspaper: www.lefigaro.fr/sciences/20060928.FIG000000066_a_marseille_la_station_marine_d _endoume_va_fermer.html

One easily understands at which point the local authority can be unaware of the official position of the French state concerning biodiversity and proclaimed by President J. Chirac during the round table "Biodiversity, cultural and ethical diversity" at the "World Summit on the sustainable development" held in Johannesburg, in 2002 and also in Paris, during the conference: "Biodiversity, science and governance".

According to Yvon Berland, professor of medicine, specialist in nephrology and president of the University of the Mediterranean which the MSE depends on, the City of Marseilles and the Region "Provence – Côte d'Azur" would like (?) to renovate three of the four buildings of the MSE in order to create a European institute of advanced research there. "A structure to accommodate foreign researchers in order to discuss planetary problems". Y. Berland also answered the biologists who pointed out that they needed to be on the coast to study the marine environment: "the astronomers do not need to be on Mars to study it".

It is not even the disappearance of the MSE which the scientists of Endoume deplore the most, it is the total absence of a functional solution of replacement. It is the total absence of vision. The MSE is responsible for the monitoring of 5 BIOMARE sites. The MSE has long-term series of very good quality over more than 30 years, series which will stop with the dispersion of the personnel in other functional marine laboratories or the abandonment of sets of themes which it will not be possible to continue any more.

It is not a question of an isolated event, touching only a few tens of French scientists. One must fear that it is only a first stage. Other Marine Stations are also the object of similar "reflection" in France and Europe. Other marine and terrestrial observatories of the biodiversity are running the same risk. The biodiversity,

important as it is at a local or a regional scale, can in no case be limited to these scales. Biodiversity must be considered at a national or a European scale and at the scale of a basin (e.g. the Mediterranean). The focal points to study it and protect it have necessarily a "known" history. It is thus vital to take care of the maintenance or the functional replacement of the structures like the marine or terrestrial stations with the greatest care and the most possible understanding.

The MSE business is exemplary of the worst that can arrive. Thus, do we need more policy for the observation and the experimentation of the biodiversity? Yes. But a scientific duty of interference when a serious problem appears is also especially needed. What is the utility of European networks? What is the utility of the EU, if everything stops at the state borders? It is not a question of anything else but of public standpoints based on scientific arguments. When informed, government and societies have finally to decide. Scientists have the duty of information helping to make the decisions.

Summary of research priorities identified in Week 1

Juliette Young, CEH Banchory, UK

Research priorities identified in Week 1 of this session include:

      1. Species and habitat status and trends:

- Further develop an accessible Europe-wide geo-referenced inventory of species and habitat distribution, status and trends, underpinned by significant new taxonomic effort, and support similar research in developing countries.
- Improve estimators ("surrogates") for overall biodiversity. Such approaches include making best-possible use of museum collections data and integrating such information with environmental layers. Estimation methodology would greatly help in eliminating the distortions in "real data" introduced by sampling methods.
- Detailed habitat mapping should be given high priority to promote conservation and sustainable management practices. Developing a consistent habitat classification (i.e. European Union Nature Information System) is also a necessary precursor
- Increased use of species information in the taxonomic literature
- Identification of currently available long-term time series inventories and making that data available and harmonized with other more current data. Where do we lack data?
- Based on the above, develop future scenarios by experiment and testing the adaptive potential of both individual keystone species as well as at the mesocosm level.

      2. Drivers of biodiversity change:

- Improve understanding of the major anthropogenic and natural drivers of biodiversity change, and their individual and combined impacts.
- Improve understanding of the factors that constitute drivers of biodiversity loss in order to develop effective policy responses.
- Improve understanding of the ultimate causes (as well as proximate causes) of biodiversity loss, e.g. growth in human population size, per-capita consumption, and socio-economic inequality.
- Increase research on the effects of local disturbance, fisheries and global climate change at the appropriate scales in order to understand resilience and adaptability of marine populations and communities.
- Increase awareness raising of the dangers of local extinctions and the decline in abundance of slow growing, poorly recruiting species.
- Understand how changing conditions (climatic, socio-economic) influence not only ecosystems directly, but also human demands on systems, services obtained, and values of those services. "Future proofing" must be considered in terms of overall sustainability and resilience of ecological-economic systems which recognise human activities, and their dynamics, as integral.
- Further work is needed on how people and industry respond to different policy instruments, and on how this interacts dynamically with ecosystem process and services.

      3. Biodiversity management:

- Develop management goals based on historical estimates of the distributions of habitats, not their vastly reduced current distributions.
- Promote the development of better Integrated Coastal Zone Management (ICZM)
- Develop a more ecosystem-based management (E-BM) approach for managing the many marine resources and the overlapping stakeholder needs.

- Review the options for a) increasing connectivity and 2) improving habitat quality. Gaps that emerge from these reviews may be used to formulate the research agenda to support the implementation of conservation measures.
- Will Natura 2000 adequately protect the biodiversity that it is meant to protect; if not, where are the main weaknesses that need to be addressed? To what extent can Natura 2000 accommodate expected climatic changes with resulting shifts in species' ranges?
- Compare habitat distributions with the existing protected areas to identify gaps in protection. To fill these gaps, there should be systematic planning for placement of new protected areas and other management measures.
- Based on the above, does the Habitats Directive need revision or even removing from play?
-Using a selection of indicator species, evaluate to what extent an assessment of population status and trends is feasible for species in the Birds and Habitats Directives.
- Research is needed into better incorporating stakeholder input in appraisal methods, including better consideration of winners and losers, and conflict resolution methods

4. Linking research with policy

- Develop methods to make science link diversity to service and on to communication indicators and management options.
- Research into indicators and decision-support tools to translate knowledge on ecosystem services into useful measures for decision-makers. Research topics include: better methods of presenting and managing uncertainty; benefits transfer and aggregation issues; relative merits of (and synergies between) discursive and monetary valuation methods
- Estimate the values of coastal habitats to provide real estimates of the ecosystem services that they provide. Better valuations of these services will illustrate for communities and governments the real costs of this habitat loss and should provide impetus and economic incentives for their protection and restoration.
- Develop measures for safeguarding biodiversity that gain wide acceptance without excessively straining state budgets.
- Develop understanding of decision-making or problems of public education.
- Study how people can use what they know already to protect biodiversity rather than assume that people must know even more before they can do something.
- Integrated research needs to be conducted at appropriate scales and levels so that efficient and goal-oriented political and management decisions can be taken at all appropriate scales and levels.
- Promote greater involvement by NGOs and community groups

RE: Summary of research priorities identified in Week 1

Keith Hiscock, Marine Biological Association, Plymouth, UK

Juliette Young has provided a good summary of points made up to now in the '2010 Targets' discussion. I am reminded of a useful paper, published earlier this year (Journal of Applied Ecology, 43, 617-627) which identified the 100 ecological questions of high policy relevance in the UK - perhaps worth casting your eye over as a starting point for your country.

On the topic of marine biodiversity conservation, we are going to need some able and influential advocates in the UK in the next year if we are to succeed in getting meaningful measures for marine biodiversity conservation into proposed new laws - now past a significant consultative stage and hopefully to go before our Parliament in the coming year. Whilst there is evidence for damage to marine ecosystems, it is often observational or suspected - and there are powerful and able lobby groups who will try to refute that 'evidence' (often because there have not been statistically testable experiments or observations to 'prove' adverse effects) and who will argue for taking account of 'socio-economic considerations' (i.e. employment and making money in their interpretation). 'Socio-economic' includes the right for our children and grandchildren to see wildlife as it should be - and that should be a powerful argument, as should precaution.

I need to clarify that my comment (included in the summary by Juliette) about setting-aside the Habitats Directive referred only to the marine environment where I emphasised that the Directive had achieved marine environment protection which would not have happened without it, but left many gaps and had shortcomings that have led to a waste of public money pursuing protection of not-endangered habitats. We now have much better knowledge and tools for marine environmental protection and management and should use them through national approaches if the Habitats Directive cannot be improved.

RE: Summary of research priorities identified in Week 1

Per Sjögren-Gulve, The Swedish EPA

In Juliette's Week 1 Summary, I want to comment on items 3 and 4: There is potential that very good efforts in biodiversity conservation can be made in the EU during the remaining 4.2 years until December 2010. I think one critical factor for how efficient these efforts will be is the extent of cooperation and communication between conservation scientists and decision-makers. The cross-fertilization of knowledge from scientists and decision-makers, respectively, is crucial. So is communication between scientists and the wider general public including young people and children.

The European section of the Society of Conservation Biology (SCB Europe) launched a resolution in February 2005 about extending the role of conservation scientists in reviews and evaluations of the EU's biodiversity conservation work (www.conbio.org/sections/europe/Policy/BiodiversityResolution.pdf). The purpose of these scientific evaluations is to examine which measures have worked well and which have not - and why. If these evaluations are done in working groups with independent scientists and managers collaborating, both will learn very much and from each other. Both can contribute knowledge and experience into the learning process, which I anticipate will be significant.

Wouldn't this be a neat cross-fertilization process? Could this be a part of the EU mechanism for independent, authoritative research-based advice to inform implementation and further policy development (action A10.1.1) in the EU Commission's new Biodiversity Strategy? Are there roles here for the EPBRS, SCB Europe, IUCN?

Message from the Chair

Terry Parr, E-Conference session Chair, CEH Lancaster, UK

Wow, that was good week. Thanks for all the contributions. Juliette Young's comprehensive summary of the key points from Week1 shows the wide variety of research you think is required in relation to the EU's policy commitments towards biodiversity and the need to protect habitats and species, biodiversity in the wider countryside and the marine environment.

But I was also struck by a number of articles that hinted that we already know more than enough to actually manage biodiversity and that we mainly lack the research, tools and knowledge for delivering effective action at public and policy levels. Of course most ecologists don't see it this way and somewhere in the middle is the idea of inter-disciplinary research, a subject covered by some contributions but not many. Am I alone in detecting that there is still a major disconnect between ecological, social, economic and political approaches which is hampering effective inter-disciplinary research? Perhaps we can put this to the test in week 2 (w/b/ 2nd October) if we look at the next two policy areas covered in the EC's "Communication on Halting the Loss of Biodiversity by 2010".

Policy Area 2 covers the EU and global biodiversity. This subject really brings the question of research priorities into sharp focus from several angles. If the main threats to global biodiversity are in the developing world then shouldn't that dictate our research priorities? And, if so, what should be balance between research designed to improve the limited knowledge base on biodiversity versus research designed to put the little we know into more immediate action?

Policy Area 3 is on biodiversity and climate change. Although this subject was well covered by the 2005 EPBRS conference in Aviemore perhaps we should test the idea that "we already know enough ecology to enable biodiversity adaptation to climate change we just need to know how to apply it".

In the final week, (w/b 9th October) we will concentrate on the key question for this E-conference: "Communication gaps particularly in relation to policy, and how we might fill them". But whatever your ideas about research priorities please keep them coming in.

Do we know enough or do we ask the wrong questions?

Peter Moll and Ute Zander, ZEF University of Bonn, Germany

Thanks Terry for your good questions. Just a short response based on our experience as consultants working at the interface between knowledge and action.

The ongoing discussion has raised questions such as: Do we know enough or not? How can we implement what we know? How can we fill the communication gaps? What are the ways in which research feeds into policy? How should we balance knowledge production versus implementation?

We would like to put these questions a little different and consequently give different answers. To our understanding there are two keywords which are instrumental for this discussion: knowledge and interface. The understanding of these two terms seems crucial for the way questions are asked and answers are given.

Knowledge: The question whether we know enough, has to be related to the kind of knowledge: know-what or know-how or know-why? Science usually focuses on the first kind. For implementation processes the other two are at least as important. The question therefore is not so much: Do we know enough? but: What kind of knowledge do we have or need to answer the problems of policy makers? This is not so much an issue of 'either - or' but much more of 'not only - but also'. Already existing knowledge of the scientific (know-what / factual / systemic) kind needs to be evaluated and integrated with regard to certain topics or problems. The results need to be worked with to be able to deal with the demands of specific target groups to fit their contexts, languages and interests. At the same time new knowledge has to be generated integrating these additional steps. In this second phase other forms of knowledge of practitioners, administrator, politicians, entrepreneurs etc (know-how and know-why / target knowledge, transformational knowledge etc.) often play a much more important role.

Interface (between knowledge and action): Many existing metaphors concerning the famous 'gap' between knowledge and action fall astonishingly short of the real challenge. The common understanding is still a one-way bridge, or some kind of funnel, through which 'the knowledge' can be fed into the brains of 'the actors'. Our common perspectives only recently started to change into a more holistic understanding of an interface where all participants are acting as well as possessing knowledge. This is an interface not only for communication and dialogue but for interaction and cooperation between those involved in the process of developing solutions for specific problems.

New research priorities especially in global change related research consequently concern not only the topics but also the way, the research is designed and managed. A 'third' type of research - besides basic and applied (technology) research - therefore is developing in many projects around the world: implementation and target oriented research. It focuses on solving 'real world problems' and contributes to implementation processes by being part of the process itself. It integrates different kinds of knowledge in an interface that involves actors from the world of science as well as from practice. It not only 'produces' new knowledge but also integrates and 'manages' its implementation.

To these questions and new developments we very recently have published a book with the title 'Managing the Interface - from knowledge to action in global change and sustainability science'. Its results are based on a study conducted over the last two years on behalf of the German Federal Ministry for Education and Research and involved working with some 70 experts on transdisciplinary and implementation oriented science. For more information visit the following website: www.oekom.de/buecher/buchprogramm/nachhaltigkeitsforschung/archiv/buch/managing-the-interface.html.

In conclusion: To our understanding the answer to the above questions is neither 'more basic research' nor 'more policy driven research'. Both 'traditional' sectors in fact need to be enlarged in the face of the challenges posed by global change and globalisation. But even more importantly, in all sectors of science our questions have to be reframed and aspects of 'how' and 'why' need to attract much more attention. This then could progressively build the ground for a third science sector approach which needs to be inter- and trans-disciplinary and issue driven and that co-exists with the other more traditional forms of science. We should not underestimate however that all this still needs more elaborated theoretical and

methodological bases and last not least practical experience made use of for further progress.

The need for compromise

Ferdinando Boero, University of Lecce, Italy

The message from the chair is encouraging and he posed questions that are relevant. I concur that we know a lot, but there is one thing that we must consider. Very often the things we know are disconnected. Not only across disciplines but also within disciplines. I described in former messages how taxonomic literature is full of information on biodiversity that is there but unused, and this knowledge refers to past conditions that might be a reference against present ones. Information, furthermore, is to be spread in a critical way, we cannot think of taking information acritically and putting it in the web. The problem is that we run the risk of not having competent people reading and using this information. So we end up trying to estimate it, while not knowing that it is there. Each field has to dig out the relevant information and the connection among the various bits. There are people who work on biodiversity and others who work on ecosystem functioning, but when biodiversity and ecosystem functioning are taken into consideration it is often the case that biodiversity specialists have problems dealing with those of ecosystem functioning. They often give different meanings to the words they use.

Our challenge is double. First we have to dig out the available information and organize it, then we have to use that information to bridge gaps among fields. I would like to say that we know biodiversity at the species level just as we know the birds (new bird species are very seldom found). We know a small percentage of biodiversity in terms of species, we know little about the status and distribution of marine habitats, we are just scratching the surface of genetic diversity. This cannot be an alibi for saying that we need research and we cannot do anything other than searching. We have to take management decisions. We have to use estimates and models, but we cannot pretend that we know enough. The two things have to proceed in parallel. We cannot freeze our knowledge on species, presuming that we know enough, and stop doing research on it. The new results that come out every day are there to demonstrate that there is a whole lot of biodiversity that we do not know. At all levels.

There is competition for funding within the scientific community, and a strong part of the community is trying to convince politicians that we know enough, and we have just to make information available and use it to make models and estimates. My position is intermediate. We need information technology, we need modelling and estimates, but our basic knowledge is still VERY incomplete and we cannot afford stop working at increasing it. These two contrasting parts of the scientific community have to work together, to gain more momentum and find better answers. I have argued in other forums that funding for basic research on biodiversity has been small when compared to that given to information technology and modelling approaches. I am referring to GBIF and ENBI, for instance, but also to many other projects that do not support research in the field.

I end with this: information is not knowledge, knowledge is not wisdom, wisdom is not truth. We cannot stop at information, presuming that we have enough knowledge. This is unwise and far from the truth. And we cannot say that we know

nothing and can do nothing. This is equally unwise and far from the truth. We need a compromise. And politicians are there for this: the art of compromise.

RE: The need for compromise

Scott Jones, Mind The Gap, UK

Ferdinando wrote about information, knowledge, wisdom, and truth, stating "We need a compromise. And politicians are there for this: the art of compromise."

I agree in part with this but would like to add something about "compromise" and where this could be found beyond the political realm. I'd like to briefly think about the conceptual aspects and then to go to a practical example that links also with issues discussed in the youth and urban aspects of this econference.

There always seems to emerge in any biodiversity question that involves different people(s) and groups, multiple realities and 'truths' that change across space and through time. People understand different things from the word 'biodiversity' - and importantly, respond at a practical level in different ways to the word.

Examples include: local classification and taxonomic systems and culturally situated understandings across the world; children's views of nature and the way they assemble their world views as they grow and comprehend things in different ways; sector or discipline-based understandings (ecologists, policy makers, taxonomists, resource managers, habitat or species-focussed conservation or protection agencies/NGOs, businesses and corporations).

As research and ideas change our views, so concepts and meanings for all these people change - many people do not have a static view of "biodiversity" and what it means for their lives, culturally, cognitively, practically or spiritually.

So as Ferdinando said compromise is needed, although there may be other ways of developing shared understandings and ways forward for biodiversity issues. In sum, "multiple truths and realities that keep changing" is part of the territory with biodiversity if we believe that diverse views matter.

Moving to the practical, I am writing up a case study now where many stakeholders have a view on an urban biodiversity conservation. The work has a strong scientific and biodiversity-focussed foundation. But it is also people and agency-focussed, involving young people, schools, communities, businesses, NGOs, local and regional government and land-based agencies.

Compromise (although we are using the words 'consensus building') is being achieved through well-structured, friendly workshops with separate groups and then bringing these groups together to share world views and build solutions on a practical level. We started with three groups - the 'community', the 'agencies and businesses' and the 'schools and colleges.'

Careful facilitation and leadership has been nurtured over a one-year period and now is being handed over to local people after some capacity building work. Biodiversity conservation work is being led by a regional-based NGO and a consortium of local schools, local business and community leaders.

Compromise (or perhaps "shared understandings and responses") is located in and through our facilitation process and sincerely embracing the multiple realities of different actors (stakeholders). The nature of the facilitation has been critical - neutral, paced, trusted, sincere, attentive and flexible (among other things).

Local and regional politicians and the Member of Parliament have been involved, but their power has been equalised with other people's (including children) by novel consensus-building techniques. They have been happy to work with this balance between representative democracy and participatory democracy in diverse groups where power is initially felt to be unequal.

Case studies haven't yet been written up fully. But a flavour of the thing can be found in the first reports from the three groups (community, schools, and agencies) that we later brought together for collective agreements on the way forward -a "linear biodiversity corridor" along an urban waterway/canal system. These may be found under 'publications' at www.mind-the-gap.net

Ecosystem services in EU Biodiversity policy: the case of indigenous European crayfish species

Catherine Souty-Grosset and Julian Reynolds, Université de Poitiers, France and Trinity College, University of Dublin, Ireland

Ecosystem services (provisioning, regulating, cultural and supporting) have become an important consideration within EU biodiversity policy. Recognising and highlighting the links between biodiversity and ecosystem services will play an important role in convincing stakeholders to avoid biodiversity losses that lead to unacceptable ecosystem services losses and hence help reach the EU goal of halting the loss of biodiversity by 2010. The report from Kettunen & Brink (2006) - focusing on a subset of ten case studies - summarises the information and insights gained and discusses the implications of the findings of the study to policy- and decision-making.

There are already quite a few examples, both global and European, revealing the multiple values of biodiversity and ecosystem services. However clearly documented examples where biodiversity/habitat loss has taken place and resulted in demonstrated loss/degradation of ecosystem services are scarce. Such examples would particularly help decision-making in situations where the benefits of environmental conservation versus the benefits arising from development are considered.

Among these case studies was the situation of freshwater crayfish, from the analyses made by the Thematic Network CRAYNET 'European crayfish as keystone species - linking science management and economics with sustainable environmental quality '. Crayfish are the largest active freshwater macro-invertebrates in the EU. It has been recognised that crayfish play a key role in the ecology and functioning of freshwater ecosystems. During the last century, however, the loss of native crayfish populations has increased due to anthropogenic pressures, such as poaching, over-fishing, introduction of non-native species, and degradation of water quality due to human activities. Several studies indicate that crayfish species are one of the most imperilled taxonomic groups in freshwaters with over 30 per cent of species being threatened or endangered.

Since native crayfish species are of major ecological, cultural and economic value, the ecosystem services degraded due to the decline of native crayfish populations include provisioning services (food provision through declines in fisheries and rearing and loss of traditional recreational fishing); regulating and supporting services (water purification, nutrient cycling and primary productivity); and cultural services (recreation, ecotourism, education). Consequently, with no envisaged long-term benefits of such losses, and with various ecological and socio-economic benefits that may be gained by the protection of these native species, the preservation of native crayfish is of crucial importance. Legislation is in place in most countries to protect native crayfish, however in many cases this legislation has not been fully successful in preventing the further destruction of populations of native species.

Unsustainable land use practices and development decisions (consequences of introduction of non native species, fragmentation of the habitats and the overall decrease in their quality mainly due to pollution) have added up and in the long term they have resulted in unforeseeable detrimental effects on the environment. Consequently, the ability of native crayfish to recover has diminished and the populations continue to decline. The worst-case scenario predicts that in the future

almost all watersheds in Europe suitable for crayfish will become inhabited by non-native crayfish species. In this case all native crayfish species will be considered critically endangered and are likely to survive only in a few protected localities within national parks/restricted areas. It is also emphasised that exploitation and conservation do not exclude each other but sustainable exploitation may be an essential tool for conservation by increasing general awareness and involving more people in protection activities.

Experts argue that it is still possible for some countries to prevent the establishment of non-native crayfish species. In order to conserve indigenous crayfish species (ICS) and to control the spread and impact of NICS and crayfish plague it is essential for managers to know the detailed distribution of the various crayfish species and outbreaks of crayfish plague in their country, as well as in adjacent countries. This is now provided in the CRAYNET Atlas of Crayfish in Europe (Souty-Grosset et al., 2006).

The strong message of CRAYNET through the Atlas (Chapter 6) is: if anyone, of whatever status (scientist, manager, stakeholder, decision maker, legislator, citizen) wants to act for the restoration of good freshwater environmental quality and particularly for the management of our indigenous crayfish populations, he or she must be first be able to identify them! This is why the Atlas provides the main references useful for helping to identify the different species. Even if able to identify them, it is recommended that workers make contact with relevant field managers and scientists and avoid any unauthorised transport of living individuals and prevent any translocations.

Biodiversity and Climate Change

Josef Settele, UFZ – centre for Environmental Research Leipzig-Halle, Germany

Summary: Ecological variability (relative constancy of habitat requirements) across species ranges gives good and relevant indication for site management under conditions of climate change: Let the management recommendations rather than the sites migrate under climate change!

In the present discussion of biodiversity effects of climate change, a majority of studies focuses on potential shifts of species with the shifts of climatic conditions (exemplified by the question in the headline of Araujo et al, 2004: Would climate change drive species out of reserves?). The integration of environmental change into conservation planning is still in its infancy. So far attempts to address the problem have e.g. used outputs from bioclimatic modelling approaches as added layers within reserve selection algorithms. For example, Williams et al (2005) applied a new method that incorporated ten-year time slice projections of species range shifts into an optimum reserve selection algorithm that allowed the identification of the necessary 'chains' of dispersal required for species migration in response to climate change.

Influenced by these discussions one increasingly comes across recommendations for practical conservation which ask for:

a) the "dynamisation" of ecological networks, allowing these networks (or areas with the respective conditions) to "migrate", or

b) creation of conditions to enable improved migration from patch to patch, e.g. by inserting new pieces of suitable habitats as stepping stones.

Under real life conditions it is very obvious that most of this will remain wishful thinking. Or is there somebody who seriously expects that areas devoted to agriculture will be converted e.g. into successional forests or vice versa? (possibly with the exception of some small pieces of land developed into stepping stones)

A very promising approach instead might be the application of research findings derived from studies with a large geographic coverage and include them into approaches for the prediction of species distributions (for most recent developments compare Guisan & Thuiller 2005).

To give an example: Within the EU project MacMan (www.macman-project.de) there were some intensive studies conducted on the ecology and habitat requirements of Large blue butterflies along a European gradient.

a) For the Large Blue (Maculinea arion; a species of Annexes II and IV of the Habitats' Directive) it has been shown by Thomas & Simcox (2005; and references therein) how in different settings management has to be conducted in order to guarantee local/regional survival of the species. At the edge of the species range (e.g. in the UK) extremely short turf is a pre-requisite to fulfil habitat requirements, while in more central areas of the species' distribution like in Central France or very hot areas in the Upper Rhine Valley in Germany, the grasslands have to be managed in such a way that turf is much higher. Under climate change it might be appropriate to "simply" (of course in a gradual way over time and space) adopt the recommendations for French sites of today for the UK sites tomorrow.

b) For the Dusky Large Blue (Maculinea nausithous; Annex II of the Habitats' Directive) there is strong indication (Hovestadt 2005; Nowicki et al. 2005; unpubl. data) that the level of disturbance has implications for the dispersal behaviour. Rather frequent disturbances force the population to remain rather mobile as habitat

conditions change rapidly and places in which the butterflies eclose might be unsuitable at the time of eclosion, thus the butterfly moves to more suitable habitats.

In the light of climate change it might be worth to put more focus on options of habitat management - incorporating landscape and landuse dynamics (see e.g. Loritz & Settele 2005; Johst et al. 2006) - in order to guarantee survival of biodiversity in areas which are already to a certain extent devoted to conservation (in particular the NATURA 2000 network). Maybe this could also be considered in future research and coordination activities on EU level, e.g. within the new projects MACIS (Minimisation of and Adaptation to Climate change Impacts on biodiversity; STREP, start: 1. Nov. 2006) and RUBICODE (Rationalising biodiversity conservation in dynamic landscapes; CA, start: 1. Sep. 2006).

Let the management recommendations rather than the sites migrate with change of site conditions due to climate change!

Recommendations for Biodiversity and Climate Change

Magdalena Muir, Arctic Institute of North America

Extensive discussion of the issue of biodiversity and climate change occurs in the Millennium Ecosystem Assessment, that is found on www.maweb.org/en/index.aspx. The impacts of climate change and biodiversity in the circumpolar Arctic are considered in Usher M. et al., Chapter 10, Principles of Conserving the Arctic's Biodiversity, Arctic Climate Impact Assessment Scientific Report (2004). Chapter 10 then influenced the paper of the Council of Europe, M. Usher, Conserving European Biodiversity in the Context of Climate Change (2005). The Third Global Conference on Oceans, Coasts and Islands took place in Paris from January 23 to 28, 2006, included a panel on oceans and climate issues, which issued a summary and included recommendations and follow-up measures (see Climate and Oceans, Summary Prepared by Magdalena A.K. Muir, Research Associate, Arctic Institute of North America, Reports from the Third Global Conference on Oceans, Coasts and Islands).

In 2006, the European Climate Change Program II has discussed adaptations of biodiversity and climate change, as one aspect of the Impacts and Adaptation Working Group, resulting in a Biodiversity Sectoral Report of September 2006. Impacts and policies for the marine environment and marine biodiversity are treated separately in the sectoral reports for Marine Resources and Coastal Zones and Tourism, also issued in September 2006. These and other reports will be incorporated into an EU Green Paper for the end of 2006. An EU conference, Adaptation to Climate Change: The European Dimension, will be held in Brussels on December 1, 2006.

More specifically to this E-conference, the European Platform for Biodiversity Research Strategy (EPBRS) issued recommendations for climate change and biodiversity conservation at a meeting in Aviemore on October 2 to 5, 2005. See Recommendations on Climate Change and Biodiversity Conservation: Knowledge Needed to Support Development of Integrated Adaptation Strategies (see www.epbrs.org). It is suggested that the E-Conference and the subsequent EPBRS meeting in Finland review all these documents, and consider supporting the related and relevant recommendations contained within these documents.

Some aspects that are very important include:

- The need to consider and take adaptive measures for biodiversity and climate change in all terrestrial, coastal and marine areas within the jurisdiction of EU member states.
- The importance of relevant and enabling policies and implementing actions at the European, national and local level, as well as appropriate and accountable governance and public participation.
- The need to incorporate private as well as governmental actions engaging the private sector for areas like agriculture, fisheries, marine shipping, tourism alternative and renewable energy etc. Considering tourism as an example, there European and global initiatives such as the European Network of Coastal Practitioners, (www.coastalpractice.net); the UN affiliated World Tourism Association (www.world-tourism.org), and the Djerba Declaration on Tourism and Climate Change, (www.world-tourism.org/sustainable/climate/decdjerba-eng.pdf).
- There is the need to consider climate change in the context of other factors such as human development, landscape integrity and fragmentation, and pollution.
- Finally, there is the need to consider geographical features such as mountains, plateaus, watersheds and enclosed seas as special areas for biodiversity conservation and climate change irrespective national boundaries. For example, the Mediterranean Sea is good example of an enclosed sea that is experiencing climate change and impacts on biodiversity (M. Muir, Climate Change and European Coast and Beach Management, www.coastalpractise.net).

Countdown 2010 will tell us the hard way how to collect, handle and sell

Peter Duelli, Swiss Federal Research Institute WSL, Birmensdorf, Switzerland

In my view, Countdown 2010 is already a great success! In 2010 we will know much more about biodiversity than only a few years ago. The cd-2010 business is a crucial process for future biodiversity research and conservation, as well as for the art of selling the truth.

Caveat 1: Around 1985, forest decline was a big issue in Central Europe. The models predicted that in Switzerland there would be no more forests within 5 years (pessimistic scenario) or 10 years (optimistic scenario). Fortunately, all models were wrong (greetings to Nando Boero). As soon as scientists started to measure forest decline seriously, the decline stopped and the indicators levelled off. What we measure today is probably the same health state as we would have measured 60 years ago. We still have severe local forest decline in Switzerland, mainly caused by extreme weather conditions, but generally the forest area and the wood volume has been increasing in Switzerland for the last 30 years.

Caveat 2: Stock market. As long as the Dow Jones Index is rising or moving sideways, nobody would speak of an economic downturn. But at the same time many firms decline or disappear, and for the affected people it is a real disaster.

So when we want to know whether the loss of biodiversity had been stopped by 2010, everything depends on what we consider to be biodiversity. We are currently almost desperately trying to find useful indicators to measure biodiversity loss in Switzerland. From the quantifiable indicators we were able to gather so far we may find out that:

- The loss of biodiversity as such (alfa-, beta-, or gamma-diversity) had been halted - or there never was one (see forest decline above).
- Most of the reliably measurable indicators (three dots or two trends) are not suitable to document a present or former biodiversity loss.
- What we presently have are about a dozen nationally representative indicators, of which almost all show no trend or an upward trend for the last 10, 20 or 30 years.

So it appears that biodiversity as such is not (no longer?) in decline in Switzerland, but single components are, which are dear to us, such as most Amphibia and the red-listed birds. But is that the great biodiversity loss addressed in the Countdown 2010?

Declining and threatened species are of particular emotional value, and the Red Lists are an excellent instrument to document biodiversity loss - at least for the few taxa, where Red Lists are available. But rare and threatened species are just one of the aspects of biodiversity loss. The rarer a species, the less ecological relevance it has for ecosystem functions or ecological resilience.

What we urgently need for the Countdown 2010 are data and indicators to document biodiversity loss for the aspects of ecosystem functions and ecological resilience. Most conservationists tend to neglect or even ignore those. Particularly in view of global change, ecological aspects of biodiversity loss should become as important as conservation efforts.

Stephen Jameson Coral Seas Inc. - Integrated Coastal Zone Management and Smithsonian National Museum of Natural History, USA

Peter Duelli in his note on "Countdown 2010 will tell us the hard way how to collect, handle and sell", stresses that "What we urgently need for the Countdown 2010 are data and indicators to document biodiversity loss for the aspects of ecosystem functions and ecological resilience. Most conservationists tend to neglect or even ignore those. Particularly in view of global change, ecological aspects of biodiversity loss should become as important as conservation efforts. I am very interested to learn how other countries solve this delicate question".

As a coral reef researcher based in the United States (but working globally), I have been leading the effort to create coral reef indexes of biotic integrity (IBI) to monitor and assess the ecological aspects of marine biodiversity loss and biocriteria to regulate marine water quality. This research is sponsored by the US Environmental Protection Agency.

Biotic integrity is defined as the condition at sites able to support and maintain a balanced, integrated, and adaptive biological system having the full range of elements and processes expected for a region. Biological integrity is the product of ecological and evolutionary processes at a site in the relative absence of human influence.

Biocriteria are criteria which define a desired biological condition for a water body and can be used to evaluate the biological integrity of the water body. When adopted by states, they become legally enforceable standards (narrative expressions or numerical values).

IBIs consist of "dose-response" metrics in the following categories (Jameson et al. 2001): Community & assemblage structure; Taxonomic Composition; Individual Condition; Biological Processes.

Well constructed IBIs contain the following mix and number of metrics to reflect multiple dimensions of biological systems (Jameson et al. 2001): Taxa richness (3-5 metrics); Tolerant-intolerant species (2-3 metrics); Trophic structure (2-4 metrics); Individual health (1-2 metrics); Other ecological attributes (2-3 metrics).

Taxonomic research

Simon Tillier, Museum National d'Histoire Naturelle, France

By delimitating, qualifying and naming the species which are the evolutionary units of biodiversity, taxonomy provides not only a large part of the knowledge base for conservation and use of biodiversity, but also the most used conceptual frame in which scientists and users see life and handle biodiversity concepts. Halting loss of biodiversity implies monitoring biodiversity at species level, both quantitatively and qualitatively. We want to know how many species are present because we have a strong suspicion that this number has some influence on ecosystem functioning; and in this matter the minimum amount of knowledge requested consisting in an estimate of the number of species present. We want also some of the qualitative information which is brought by taxonomic names, because names in turn give access to relevant biological and ecological information.

Recent research results indicate that, even in Europe, we are hardly able to determine how species there are, both locally and globally, and taxonomic research works at overcoming this impediment through several approaches:

- Most generally research needs to refine its concepts and methods of delimitation for species. Most species have been circumscribed and named empirically, but if we want accurate, repeatable and reliable comparisons for monitoring we must first make sure that the concepts corresponding to species names are the same.

- We are describing new European animal species now just at the same rate as several decades ago, without any indication of decrease, which indicates than even in the scientifically most developed region in the world we are lacking taxonomic information just as much in proportion as in tropical regions (Fauna Europaea report). Research can improve its production, both qualitatively and quantitatively, by establishing collaborative tools on the web ("Cybertaxonomy") such as developed in EDIT.

- We are unable to sample all species occurring in any single place, from prokaryotes to large muticellular organisms (All Taxa Biodiversity Inventories = ATBI concept). Should we know how to sample, we would not find the expertise to give names to all species present. This is by far the heaviest impediment to reliable measure of taxonomic diversity, which however is addressed through several approaches: establishment of standards and protocols allowing comparisons without exhaustivity (eg EDIT WP7); molecular tags allowing identification of species without going through the whole taxonomic processing (sampling organisms, sorting, comparing, naming specimens), as developed in the Barcode of Life initiative; and finally modelling of species distribution through statistical analysis of georeferences from collections, allowing virtual inventories which may be compared with actual occurrences in the wild and thus allow an estimate of the trends (eg GBIF planned developments).

- The existing taxonomic knowledge is highly fragmented and de facto not available to users other than researchers working in large taxonomic facilities. Substantial progress in understanding loss of biodiversity may be expected from simple pooling of existing knowledge and data, as started through the GBIF. This perspective implies the development of a very large distributed research infrastructure, allowing processing of biodiversity data from observations, collections

and documents to transparent use of informatics tools providing a direct estimate of biodiversity and its potential change, as proposed in the Life Watch project.

RE: Taxonomic information

Ferdinando Boero, University of Lecce, Italy

I am very sympathetic with the position of Simon Tillier. I do not share his enthusiasm for GBIF and ENBI, though. The core of taxonomic information is the literature. Taxonomic literature stores all the information on species and supraspecific taxa. The first thing to be made available to provide biodiversity information is taxonomic literature, through web based virtual libraries. Without a library you cannot do taxonomy.

Let's not confuse taxonomy with identification. Taxonomy gives names to species, and this is often considered as synonym of giving names to specimens. Under many circumstances, identification keys in the web are considered as a beautiful end product of taxonomy. Or lists of species that are not revised through taxonomic revisions. Or lists of type specimens that, anyway, are already known to specialists and are useless to non specialists (who will ever ask for a type specimen if not for making a taxonomic revision? I make taxonomic revisions and I can find the location of types in the literature, then I write to museums and they send me the type specimens, it has always been like this).

The difficult thing is getting hold of old and hyper-specialized literature. Strangely enough, all these initiatives in Europe, on biodiversity information, do not provide the most crucial information on biodiversity: literature.

And there are no EU projects aimed at revisionary work. Not to speak about collections and biogeography. The attitude is: the information is there, let's put it on the web. This is a very wise move if, for information, one means the literature. But information, in these initiatives, is everything but the literature. And a substantial amount of money for taxonomy goes to information technology firms and to some museums for their type specimens. Not much to taxonomists. This policy should change.

Big Museums have to receive money from the EU to scan all their libraries and put them in the web in a critical way. Stemming from the Zoological Record, and also before 1864. This is one of the aims of the partnership for enhancing expertise in taxonomy (PEET) and this enterprise is being done for the Hydrozoa, in Europe, with US money. We need revisions and exploration, among others. Not only that, but also that. Now this is not pursued enough with the aid of the EU.

RE: Taxonomic information

Isabella Van de Velde, Royal Belgian Institute of Natural Sciences, Brussels, Belgium

I just want to reply to Ferdinando Boero's remark: "And there are no EU projects aimed at revisionary work. Not to speak about collections and biogeography". On the

contrary, there is EU funding for the study of collections for the purpose of revisionary work and basic taxonomical research.

SYNTHESYS, a European Union-funded Integrated Infrastructure Initiative grant is a five-year project, which began in February 2004. In fact, SYNTHESYS is split into two activities: Access (to collections!) and Networking Activities.

The SYNTHESYS Access funding is available to scientists (based in European Member and Associated States) to undertake short visits to utilize the infrastructure (namely the collections, staff expertise and analytical facilities) of 20 European natural history museums and botanic gardens. To gain access to the collections, facilities and expertise held, researchers must enter a competitive call for applications. If successful, SYNTHESYS will cover their research, travel and living costs while at the TAF. The maximum visit duration is 60 working days per Taxonomic Facility over the 5-year duration of the contract.

On SYNTHESIS and other EU projects

Ferdinando Boero, University of Lecce, Italy

SYNTHESYS is a little help for somebody who has funding for revisionary work and needs to inspect a collection. It is however not a serious funding source for revisionary work. A revision is not made by just going to a museum to seeing some specimens. A NSF-PEET-funded revision of the Hydractiniidae cost about $250,000, five years of work, innumerable trips to collect new specimens, inspection of museum specimens, molecular analyses and so on. This is leading to the description of new species, and to a phylogeny based on both molecular and morphological analyses. Just a small amount was spent to visit museums. In the EU, that little amount is covered by SYNTHESYS. What about the rest?

If we want to compete with the US in taxonomy we have to do more than SYNTHESYS. The people who work in Museums are more or less happy, their end scope is to do taxonomy, and their funding is often fixed and they do not have to fight for it. But are we saying that taxonomy is possible only in Museums?

So, SYNTHESYS is good but it is a drop in the sea, as are the other EU projects on biodiversity. And there is not only SYNTHESYS. The EU spent a lot of money in support of taxonomic research (see attached figure). They all provide services for somebody who should do taxonomy. But these services are only meaningful if one has a financed project to do the rest of the things that are needed to study taxonomy. There is none on literature. Many are supports to museums to let people visit them. There is not a single project on the revision of a single taxon. I do not say that all the money has to go in that direction. But zero is a little extreme. I presume that Museums are happy with these choices. I work in a university, and I am not. By the way, if the universities do not study taxonomy, then there will not be students who will be motivated in working in taxonomy. Most of the graduate students that worked with the PEET came from non-US countries, because US university students perceive taxonomy as an obsolete discipline. In spite of the excellence of the Smithsonian Institution, the Field Museum, the American Museum of Natural History, you name it. They launched the PEET because they understood something that, in Europe, we refuse to understand. We will in twenty years, the usual lapse between us and them. By now we are better than the US in taxonomy, but soon we will not. They have a strategy, if you look at these 20 projects it is evident that we

do not or, if we have it, is more focused on getting information (besides literature) and make it available, not on generating new one.

Sorry folks, taxonomy is not only inspecting corpses in little vials or making unrevised lists of taxa. It is also that, but not only. We need revisions. And revisions need focused funding.

Table 1. EU initiatives devoted to biodiversity research

Project	Description
ABC	Improving Human Potential (IHP) project allowing European researchers to work on Belgian collections
BIOCASE	A Biological Collection Access Service for Europe.
BioCISE	Resource Identification for a Biological Collection Information Service in Europe.
BIOD-IBERIA	IHP project allowing European biodiversity researchers to work at Museo Nacional de Ciencias Naturales and Real Jardín Botánico.
BIORESOURCE	IHP project allowing European researchers to do systematics research at the British Natural History Museum, Royal Botanic Garden, Kew and Linnean Society of London.
CDEFD	Prepared a common data structure for European Floristic Data-bases.
COBICE	IHP project allowing European researchers to work on University of Copenhagen Biosystematics Centre collections.
COLPARSYST	Follow-up to PARSYST (see below).
ENBI	A network of biodiversity information centres of the western European Palaearctic allowing European researchers access to technical and human resources, and biodiversity expertise.
ENHSIN	An infrastructure of European natural history specimen databases developed by the European Natural History Specimen Information Network.
ERMS	Developed the European Register of Marine Species.
EURO+MED Plantbase	Provided an information system for the vascular plants of Europe and the Mediterranean region.
EuroCat	Will enumerate and provide web access to basic taxonomic information on all known species of plants, animals, fungi and microbes: see Species 2000.
EUROFLUKES	Developing a database of photos of cetaceans.
Fauna Europaea	Assembling a database of scientific names and distribution of all existing multicellular European land and freshwater animals.
HIGH LAT	IHP project allowing European researchers access to collections and facilities of the Swedish Museum of Natural History.
PARSYST	IHP project allowing European researchers access to systematics collections and facilities of the Paris Natural History Museum.
SYS-RESOURCE	Follow-up to BIORESOURCE.
TAXIP	Allows informatics researchers access to taxonomic information facilities processing of the Zoological Museum, University of Amsterdam.
SYNTHESYS	Focuses on access (to data, collections and expertise), policies and standards relating to the large natural history collections of Europe.

RE: On SYNTHESIS and taxonomy

Wolfgang Waegele, Rheinische Friedrich-Wilhelms- Bonn University, Germany

I fully agree with Ferdinando Boero's statements on taxonomy. SYNTHESYS is helpful, but it does not make species-based biodiversity research visible. Europe's vanishing population of specialists is just beginning to understand that doing good science is not enough to survive, they have to cooperate and they urgently need support. They are not well organized; CETAF represents only a portion of scientific community. Even in the museums the number of taxonomists is decreasing, because these institutions are urged by evaluators to implement laboratories for molecular biology, others are doing more comparative anatomy than species-based research. The situation in our universities and the consequences for the awareness of young biologists has already been discussed. It is high time for a concerted action to conserve and promote the expertise required for many other fields of science.

Taxonomy is a strategic science, and by the dimensions we have to cope with it is a megascience that suffers from lack of infrastructure, lack of cooperation and lack of support.

An outstanding challenge is to speed up biodiversity discovery, description, and assessment. Due to the lack of manpower inventorying is a slow process. New techniques that could be used exist, but they require methodological research and databases. Without taxonomists it is not possible to develop automatized expert systems.

Taxonomic research and 2010

Dan Faith, Australian Museum, Sydney, Australia

I was inspired by Simon Tillier's entry on taxonomic research needs, which was both passionate and pragmatic. He described a sensible way forward, in "the development of a very large distributed research infrastructure, allowing processing of biodiversity data from observations, collections and documents to transparent use of informatics tools."

However, I suggest some minor shifts in perspective that may better serve the research needs for 2010:

1) Rather than emphasise on "the minimum amount of knowledge requested consisting in an estimate of the number of species present", I think pragmatic biodiversity conservation planning often will need estimates of marginal gains/losses rather than estimates of total species numbers in a given place. Priority research for expanding taxonomic knowledge may focus on those taxa, and those places, that best increase the prospects for the modelling referred to by Simon Tillier, and its application to planning and assessment for 2010 (see Faith, 2005).

2) I was intrigued by the proposal to first make sure "that the concepts corresponding to species names are the same". I think that a standard concept is possible (based on a generalized lineage concept; see Faith, 2004), but this will not really help us address the 2010 biodiversity target. The pressing needs for addressing the 2010 target perhaps point to the need for the molecular "tagging" approaches highlighted by Simon Tillier. This approach, rather than a standard species concept,

may provide the standard, comparative, data needed urgently for conservation planning for 2010. Research is needed to explore how a rapid, large scale DNA barcoding program might be used for conservation planning for 2010. I think this could be another pathway for the SCP approach (see previous D. P. Faith entry on Faith-Ferrier SCP analyses, in "How to reach the 2010-and beyond- target: research influencing policy" or references).

The figure below illustrates the link from a DNA barcoding database to Faith-Ferrier SCP analyses for the 2010 biodiversity target. The analyses were applied to phylogenetic and geographic information from the public "Barcode of Life Database" (arctic Collembola of Hogg & Hebert, 2004) for 19 taxa and 7 localities or 'sites'). The example suggests that, if sites are going to be lost from protection at a constant rate, SCP selection of sites protected-versus-lost could reduce the rate of biodiversity loss.

Research may develop this kind of link between rapid expansion of our biodiversity knowledge base and the analyses and planning that measure achievement of the 2010 target.

Figure 2. SCP analyses for the 2010 biodiversity target
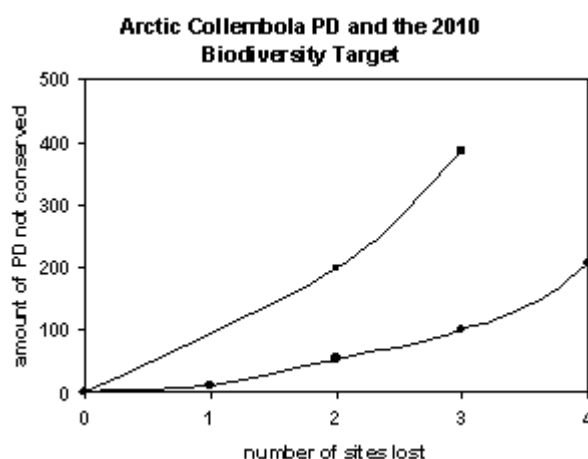
Any point in the space indicates the overall status of the 7 sites; the vertical axis is the amount of PD not represented by the protected/intact sites, and the horizontal axis is the number of sites protected, or lost from protection. If sites are going to be lost from protection or intactness at a constant rate, SCP selection of protected-versus-lost sites (lower curve) can *reduce* the rate of PD loss. Each point corresponds to a protected set with loss of one site relative to the point to its left. Upper curve illustrates one possible sub-optimal progression of site losses.

The need for interdisciplinary research

Frank Waetzold, UFZ - Centre for Environmental Research, Leipzig, Germany

Having worked as an economist with natural scientists for several years I am always amazed when ecologists or economists alone claim that they are able to develop recommendations for biodiversity management.

Naturally, some aspects of the management problem can be well understood within a disciplinary approach. For example, the estimation of the size of the protected areas required to provide desirable conservation outcomes for threatened plant species may not require any economics. Similarly, the analysis of how the lobbying process of environmental and industrial groups affects timber harvesting and thus conservation may not require any input from ecology. But the selection between alternative sites or the analysis of the ecological impacts of the lobbying activities would certainly require an interdisciplinary effort. In fact most biodiversity management problems include ecological and economic aspects, and adequate recommendations directed at such problems can only be developed if knowledge from economics as well as ecology is taken into account in an integrated manner.

However, is it not sufficient to let every discipline do its own work and then put the results together in an edited volume of a book or a special issue of a journal? The answer is no because of (1) the incompatibility of disciplinary solutions and (2) the lack of feedback between ecological and economic systems. Regarding (1): If scientists work separately in their own disciplines, each discipline poses the problem in its own way and comes up with its own "most appropriate" solution. These disciplinary solutions, however, are likely to be so different that a combined solution considering aspects of both disciplines cannot be found. To illustrate, consider the problem of reserve site selection. In a purely ecological reserve selection algorithm, the analyst maximises the number of protected species within the constraint of limited total habitat area and derives a set of reserves to be protected. The corresponding purely "economic" problem – which, in a sense, is "complementary" to the ecological one – is to minimise economic costs of habitat area under the constraint of staying above a certain threshold on the total reserve area. Even though this total reserve area may be identical to the one in the "ecological problem," the economist derives a different set of reserves to be protected relative to the ecologist. Although each of the two sets of reserves solves the distinct ecological and economic optimisation problems, neither solution meets the integrated and superordinate objective of maximising the number of protected species at given total costs (Ando et al. 1998).

Regarding (2): A disciplinary approach is unable to address feedback loops between the ecological and economic system. The importance of such feedback has been demonstrated by, e.g., Settle et al. (2002). They show how nature park visitors adapt their fishing behaviour to the abundance of a fish species (cutthroat trout); the higher the abundance, the more people fish, which may either stabilise or destabilise the fish population. If no interaction of the cutthroat trout with other fish species is assumed, the described adaptive fishing behaviour represents a negative feedback and has a stabilising effect because population growth of cutthroat trout increases as fishing pressure decreases. But fishing also affects the abundance of another fish species, the lake trout, which leads to a positive feedback. Decreasing fishing pressure increases the abundance of lake trout, which increases their predatory pressure on the cutthroat trout which in turn decreases the growth rate of cutthroat trout. As Settle et al. demonstrate, depending on the type of population management this positive

feedback can lead to the extinction of the cutthroat trout population which without such a feedback would be viable. Integrated research here is crucial in detecting an important risk to the cutthroat trout population.

There are an increasing number of economists and ecologists who value the benefits from interdisciplinary research. It has become a kind of fashionable among economists to publish their (integrated) research in traditional conservation ecology journals such as Biological Conservation or Conservation Biology. Similarly, ecologists have expressed an interest in working with economists (e.g. Roughgarden 2001). If you go through the relevant journals you find that these interests have materialised in an increasing number of articles written in joint authorship by ecologists and economists. For the benefit of biodiversity conservation such trends should be encouraged.

The main arguments and examples presented here have been taken from Wätzold et al. (2006).

RE: The need for interdisciplinary research

Dan Faith, Australian Museum, Sydney, Australia

It was great to see this call for more interdisciplinary research. In the context of the 2010 biodiversity target, arguably too much of the focus on indicators has been "biodiversity-centric", and has not appreciated the need to incorporate economics – both through consideration of other values of society (opportunity costs of conservation and so on) and through the range of economic instruments (e.g. payments to private landowners) that can form part of any successful approach to achieving the 2010 target.

My previous contribution outlined an interdisciplinary, multi-criteria, approach to the 2010 target, and I highlighted the need for integrating the relevant biodiversity and economics needs:

1) Improved estimators ("surrogates") for overall biodiversity are needed. Such approaches include making best-possible use of museum collections data and integrating such information with environmental layers.

2) Realistic estimates of opportunity costs of conservation, and their distribution, are needed, including ways to combine different costs.

Our approach is based on extensions of that "reserve selection" paradigm referred to by Frank Waetzold. I liked the example illustrating how neither an all-biodiversity nor an all-economics approach would be effective. It was interesting also that the call for interdisciplinary research in this context used the 1998 publication by economists, while this lesson was earlier appreciated by biologists (Faith et al 1996). Frank Waetzold certainly is correct in highlighting the need for much greater cross-discipline communication and collaboration.

All this further highlights the research challenge of finding a way to take advantage of all the effective economic/biodiversity instruments that are already out there - and not only use these in a way that better addresses 2010, but also determine how their effective use can be "credited" as helping to reach the target.

When do biodiversity researchers know enough to stop the biodiversity decline?

Paul Opdam, Wageningen University Research, The Netherlands

I would like to express my worries about the many contributions, which seem to assume that if ecologists provide society with enough taxonomic knowledge, process indicators and decision-making models, the biodiversity decline will be stopped by that same society. I would like to discuss two major arguments why these assumptions are doubtful.

1) To me, the question here is not whether we know enough (we probably never will agree on that). The question is how the knowledge that we already can offer to society is actually being used. An increasing number of papers in the international literature claims that it is used very poorly. Scientific ecological data are poorly used, even by nature reserve managers, let alone by the general public and policy makers. Most so-called decision support tools are made by scientists in their office, and not useful or understandable to actors in regional planning processes. Most ecological knowledge is on processes, and stresses the diversity of species responses ("every species is different") instead of linking processes to spatial pattern characteristics that can be influenced by planners and other actors. Most scientific ecological information is simply too complex and misses the essential links to land use decision-making.

2) The general citizen, entrepreneur and decision maker have no idea why biodiversity would be important to their personal interest. They have no clue why investing in better, bigger or more cohesive structures of ecosystems in their region could be beneficial to the economic future of the region, and to their own quality of life. Biodiversity conservation is getting focused on rare species and habitats, and in this trend we are losing any sense of urgency on the importance of biodiversity. The people that make the decisions on economic and social development do not incorporate ecological sustainability into their decision-making, except for goals connected to nature conservation law.

The first point will be dealt with in the next week. The basic solution here is to recognize that developing useful indicators, tools and decision making systems require a thorough understanding of how governance processes are structured, at the various scale levels, what motivates people to invest into ecologically sustainable landscapes, and how scientific knowledge should be constructed to be applicable in decision making. Hence, we need to understand how the link between ecological science and decision-making science and practice can be made. This calls for a fundamentally different model of knowledge transfer: from a linear to a network model, in which scientists learn from application and learn how to insert local knowledge into their generic tools.

The second point urges for making links between ecology and social and economic values. It calls for ecosystem and landscape services, and it calls for linking these to ecological, social and economic costs and benefits. Ecology should be part of integrated decision making on sustainable development: the main actors should understand why and accept that development is never sustainable without considering biodiversity. That needs urges for interdisciplinary research. I strongly support Frank Watzold's view on cooperation between ecological, social and economic disciplines here, and would like to add the planning and design discipline.

RE: When do biodiversity researchers know enough to stop the biodiversity decline?

Jonathan Sadler, University of Birmingham, UK

I think this post hits the nail right on the head. Pretty much all of our research over the last few years has shown that the 'science' used in city design and planning derives from a variety of different sources and relates to the experience (and some cases enthusiasm) of the professionals involved in the process (landscape architects, architects, planners, councillors and so on) and the public who inhabit or will be inhabiting the spaces created (residents, workers etc). They all have a different opinion on issues which to us as ecologists might seems self evident. They derive this from their own experiences of the science as they have gleaned it from the literature, TV, newspapers, Web and how they feel about the space (landscape) itself.

The one consistent theme in this work is that complex science is not readily assimilated by the people in the system. Maybe we have a responsibility to make the issues more accessible? This point comes sharply into focus when people ask questions like: "How much of this habitat do we need to preserve populations of this species (e.g. Great-crested newts or Black Redstarts)"; "Will four green roofs do?" etc.

As there is no (or many) 'right answers', I suspect the best we can do as a community is focus on spatial issues and getting the ecosystem processes into place and hope that the rest looks after itself. A similar debate is taking place within aquatic and riparian ecology.

Developing transdisciplinary perspectives for biodiversity scientists

Carsten Neßhöver, Dirk Schmeller & Klaus Henle, UFZ - Centre for Environmental Research, Leipzig, Germany

Summary: Transdisciplinary perspectives are urgently needed to cross the gap between science and policy implementation

We would like to come back to Paul Opdam's point on the importance of bridging the gap between scientific ecological knowledge and policy making/implementation by presenting two examples from our current work to outline the problems of those gaps. We finally summarize our ideas with reference to some earlier contributions of this e-conference.

Example 1: Translating the Millennium Ecosystem Assessment for national use: One year ago, our institute was asked to undertake a comprehensive review of the relevance of the Millennium Ecosystem Assessment (MA) for Germany. Since that required quite different knowledge and expertise, the review was carried out jointly by social and natural scientists form different disciplines.

While working on the study and communicating it later to policy makers and practitioners it became clear that the MA has two main dimensions. (1) The concept of concentrating on "ecosystem services for human well-being" makes it much easier to communicate the danger of environmental degradation and biodiversity loss to these stakeholders. It concentrates on the issue (raised several times in the e-con discussion) on how to involve people's everyday life into the discussion. (2) Although

the concept is to some extent intuitively understandable to stakeholders, scientists with a firm background in interdisciplinary and applied sciences are needed to break down the information from a global and complex context into the context of everyday policy (for outcomes of the project, visit www.ufz.de/index.php?de=10377).

Example 2: Collection and analysis of monitoring meta-data - The EUMON-project: The EUMON-project http://eumon.ckff.si/ is designed to directly contribute towards the 2010 target by streamlining monitoring activities. Its main aim is to collect information on monitoring schemes in Europe on species and habitats to derive best practice recommendations on different geographical and political levels to improve monitoring towards 2010 (and beyond).

While the MA example is a somewhat top-down approach ("explaining" the global findings to the national level"), EUMON works the other way: collecting bottom-up best practices to synthesize the outcomes directly towards policy making. Again, scientists have the role to mediate solutions somewhere in between highly scientific, expert knowledge and needs from policy.

Conclusions: From our point of view the examples illustrate that developing the personal basis for policy-science-communication for global change issues is urgently needed (the growing number of projects dealing with climate change adaptation and current conservation measures are another example discussed in the e-conference). We need to find ways to bridge sound science making and policy making and implemenation more effectively. We need to stress (and explain) again and again the importance of interlinkages between different aspects of biodiversity loss and global change issues. Of course, scientists have to adapt to such roles and such work has to be acknowledged within scientific careers (see EPBRS-recommendations of science-policy-interfaces: www.epbrs.org/PDF/EPBRS-NL-2004-science%20policy%20interface-_Final_1.pdf)

Consequently, this also implies the high importance of social scientists to be involved in such processes. It may be that one reason why biodiversity is so unsuccessful in promoting its goals to society is its (still) overwhelming concentration on natural sciences. The MA clearly shows that biodiversity loss is a major socio-economic problem and less one of sound ecological knowledge basis (see also contribution of Mikael Hildén).

Concerning research recommendations we therefore think, that of course the development of science-policy interfaces in research projects, as outlined by Sybille van den Hove needs to be developed further, but also that we need to go beyond that and include transdisciplinary work directly within projects. The ecosystem services-concept of the MA might be helpful to develop a first framework for the further development of such efforts.

Natura 2000 and Red List species

Kajetan Perzanowski, Museum and Institute of Zoology, Polish Academy of Sciences

I thoroughly agree with arguments given by Paul Opdam. It doesn't matter what advice or expertise is given by ecologists, until decision-makers (and indeed the average citizen) understand why we all should make efforts and bear expenses to conserve biodiversity, nature, rare species etc. That of course calls for an involvement of PR experts, sociologists, economists and so on.

However there is also another aspect that bothers me, as it was stated in an earlier contribution: it is already difficult for experts to agree on what is the biodiversity we want to preserve. How then are we going to convince people that are not ecology specialists about the urgency and importance of such actions?

I fully support the statement that probably we will never have a complete picture of biodiversity including all levels of micro-organisms, genes etc. To make a plan to stop biodiversity loss by a certain defined date seems therefore not truly realistic. In this situation of limited knowledge and understanding of the problem a solution could be to concentrate on items that are fairly well documented, and possible to evaluate in both quantitative and qualitative ways. At the moment, (however far from ideal) the only more or less universal system for the assessment of valuable natural areas and communities in Europe is the Natura 2000 network. Since it is supposed to be verified every couple of years, and in a similar way all over the continent, it may serve as a platform to assess whether the biodiversity loss takes place at the community-ecosystem level. Then the presence, abundance, population trends of red list species (which are fairy well known and enjoy a higher than average level of attention) may serve as indicators of biodiversity trends at species level. Many of those organisms fulfil the role of umbrella or keystone species so their fate can be crucial or at least important for other components of the biosphere as well.

If we could say that we can maintain present level of biodiversity measured by the quality and size of Natura 2000 sites network, and the population parameters of European red list species for next quarter of the century, it would probably mean that the next generation of Europeans could enjoy living conditions no worse than ours.

RE: Natura 2000 & Red Listed species

Przemek Chylarecki, PAN Museum and Institute of Zoology, Warsaw, Poland

I really doubt whether the proposition that Natura 2000 areas and red-listed species can indeed serve as proxies for monitoring of biodiversity loss in general. Natura 2000 sites represent areas which are particularly rich in a subset of species, and as such they are not representative for the biodiversity on a wider scale. For example, if we sample bird communities on 20 randomly selected plots (1km x 1 km) within Natura 2000 areas we can expect to find 130 species, while for the areas outside Natura 2000 network the expected value is some 15 less. Or other way around – to get info on the occurrence (& trends) of 130 bird species we must sample 21 such plots within Natura 2000 versus >40 plots outside the Natura network. These figures refer to Poland, but the point is quite general – Natura 2000 sites are not representative – in terms of biodiversity – for the country as a whole. The same applies more or less to red-listed species. This makes a difference, since – I believe – we should monitor and protect the biodiversity on the level of wide countryside rather than focus on areas covering some 15% of country area (like Natura 2000).

I must stress I am not denying the value of Natura 2000 as such. Conversely, I am convinced it might be a quite powerful tool in slowing down the biodiversity loss in Europe. And it may be enough for a number of localized and rare species. However, I think the ultimate fate of biodiversity lies on the 85% of the European area which will not be protected as Natura 2000 sites.

Why are landscape developers so unwilling to hear about ecological sustainability?

Adrienne Ortmann-Ajkai, Hungarian Society for Environmental Education

Thanks to Professor Opdam for writing so clearly many thoughts which I was trying to formulate myself when reading the contributions. The situation he describes is similar to our experience in Hungary.

The national habitat GIS database (MÉTA: see www.novenyzetiterkep.hu, partly in English) was created between 2002-2005, with the contribution of 200 botanists' 10000 days of field work; covering the whole country with a pixel size of 600 m (280 000 pixels), with data on habitat types, natural values, landscape ecology, land use, endangering factors, regeneration potential, etc. Even in the planning phase possible demands of sectors other than science (nature conservation, forestry, agriculture, development) were taken into account, so that the database is able to answer questions from users outwith the scientific community. The database is ready, with public online access, and we are trying to persuade planners and decision-makers of other sectors to utilize this information – geo-coded, with many analysis options and expert help - all of which is vital for ecologically sustainable management and development.

However, for the last 2 years, we have had very limited success. Other sectors seem to be perfectly satisfied without it. We are especially sorry and anxious that we cannot reach the landscape development sector, the Regional Developmental Agencies, distributing EU developmental money, partly labelled for "sustainable development". Sustainability in most cases is understood only as financial sustainability; if "ecological sustainability" has to be stressed, it is mostly an empty phrase. If biodiversity experts had more opportunity to get involved in planning projects – or at least existing data would be used more - projects could be more sustainable ecologically. We want to be involved, that means we want to work, to think together about solutions bringing together expertise and interests of different participants in a structured and balanced way. We are looking for successful experiences on how to develop successful communication and cooperation between researchers and with other sectors, mostly with landscape development planners and decision-makers.

We are convinced that education in the broader sense, attitude-forming, is vital to make the public more sensitive to ecological and conservational questions, make them consider these values as important as social and economic ones. So we have launched a common project with the educational sector called "local MÉTA workgroups" utilizing GIS databases with locally relevant data. Through these workgroups – planned to work partly on local sustainability projects – we hope to reach local authorities and decision-makers, as there are already some success stories in Hungary of school-initiated local sustainability projects – but there is a very long way to go.

Using existing tools

Gabor Nechay, Ministry for the Environment, Hungary

I wonder whether you recognized the essence of Adrienne Ortmann-Ajkai's contribution? She described the establishment of a database which is a useful tool for the regional development and other sectors, and an application of science on the conservation and sustainable use of biodiversity. However, this tool is ignored by users, by sectors involved and responsible for BD. Looking for the reasons she also refers to the importance of communication and cooperation with researchers and other sectors.

This would require particular attention and separate conference(s), including the general and specific communication failures of conservationists/ecologists. Now, I agreed with Prof. Opdam's view on communication and with Dr. Bardsley, Frank Watzold and others on cooperation of various disciplines, as well as the particular question of monitoring outlined by Przemyslaw Chylarecki. However, all these need a long time and they are not enough. Consider that since 1992, the adoption of the CBD, good tools can still be ignored, such as described by A. Ortmann-Ajkai. In order to avoid that, administrative tools should be developed, i.e. recommendations (at least) from the EPBRS Meeting in Helsinki to the Council (Brussels) on the establishment/adoption of appropriate tool(s) on mandatory use/observation of such (already existing) tools by various sectors and especially during regional development. In spite of the fact that such tools can never be perfect/faultless. But at least their consideration and examination by the public sector and in certain cases by stakeholders should be compulsory.

RE: Using existing tools

Cornelia Nauen, European Commission, Brussels, Belgium

If it is true, as several participants stated based on empirical observation and other evidence, that the perceptions of groups in society (informed by their own history, culture and perspective) do not coincide with those of researchers investigating the fundamentals of nature (and society), the question posed is, how to bridge the gap.

If citizens can not easily connect to the presentation of fundamental in scientific code, perhaps one can find communication pathways to bridge the perception gap and give them access after all.

One place where citizens with a wide range of interests meet scientific information on biodiversity is FishBase: www.fishbase.org - actually, there are several million of them every month, more than there are fish specialists around. That convinces me that the bridging can be done. However, that does not automatically mean that the politics will fall into place and action be taken quickly.

RE: Using existing tools

Pedro Fernandes, Institute Gulbenkian de Ciência, Portugal

I fully second Cornelia Nauen's contribution. The bridge through the gap is evidenced there. However, we should also look around and see how this is done in other areas, such as health.

Health is something that every human being values, sometimes more than life itself. Underlying everything there are hundreds of databases, information systems etc. The general public does not bother to understand if the data are disease, clinic, genomic or pharmacological. The general public sees what is served in several fashions, depending on the needs. Yet the scientific origin and agreement are a fundamental ingredient for acceptance.

The bottom line is that scientific credibility is there. The information that supports evidence and decision-making is scientifically credible. The way to serve it to the citizens suits the citizen's aspirations, taking that credibility for granted.

The citizen looks for an easy way to get "complete" and up-to date information on a health problem. The citizen does not care very much on the process that was used to draw conclusions and present them. He/she cares about reliability and ease of perception of the acquired knowledge. He/she does not care if the support for reasoning was obtained experimentally, clinically, molecularly, whatever. But he/she relies on the credibility.

Have a look at how this is served to the citizen at http://health.nih.gov/ and then see the several sources that they use, such as www.ncbi.nlm.nih.gov/ for the molecular world or www.genome.gov/Health/ or www.genome.gov/10000409

Consumers look at easy ways to digest science, provided that no loss of credibility is felt. This is just one example.

RE: Using existing tools

Norbert Hirneisen, science4you Online-Monitoring

Yes, it is possible to bring the interested public and the scientists together: we have been showing this since 2003 with our online monitoring tools (www.science4you.org and several projects using our basic web-application: Globis www.science4you.org/platform/lex/globis/index.do, German Butterfly Monitoring and now naturbeobachtung.at, an online tool to share nature observations in Austria).

Our first project deals with migratory butterflies and moths and since 2003 more than 1000 members have registered to our website. We are getting over 20.000 recordings per year, still increasing. Every 9th record is accompanied by a picture upload and thanks to some hard working amateurs we can maintain a pretty good data quality. But I have to state that the problem in bringing together scientists and the public is not lack of interest in nature themes in general but the lacking ability of scientist to deal with the needs to bring nature themes to the public: the focus must be on fun using the tools, sharing information by picture discussions, solving puzzles on blurred images and so on. We have only a very small number of active scientists on our websites: scientist don't have time to keyboard their daily observations and they

are getting bored by answering the same questions ten times a year on the discussion board.

To involve many people in nature observation and to "market" the richness in biodiversity as a big plus in our lifestyle we have look at the needs of our target group and we have to involve marketing specialists and advertising skills. We have to develop applications and we have to shape projects from the tool-users point of view and not from the datamining-users point of view. And that is widely regarded as non-scientific.

What is the evidence-base for biodiversity policy?

Andrew Pullin, University of Birmingham, UK

I agree wholeheartedly with a number of contributors who have emphasised the advantage of using existing tools to enable current scientific evidence to be used in the policy process and for knowledge gaps (and therefore research priorities) to be identified. Just a few points....

1. There is a large and ever-increasing amount of scientific evidence on biodiversity issues but this is hopelessly inaccessible to all but the most determined individuals.

2. To construct an evidence-base that is accessible for policy we need a methodology which collects and synthesises the evidence in a rigorous, unbiased, repeatable and transparent way. The resulting library must be shared by the community that produces it and be open access to the users.

I definitely agree with a previous contributor who says that if we wait for a perfect method then we will just carry on talking and nothing will get done. A methodology already exists to formalise what we do and do not know and I urge others to examine the following website as an example: www.cochrane.org

This existing tool is not the complete answer to our problems but it does do a lot of the things for the health sector that we desperately need to do for biodiversity.

I hope to be able to update delegates in Helsinki on the collaborative work being done to create a biodiversity equivalent to the Cochrane Collaboration.

A parable: the leaning tower of Pisa

Richard Scott, National Wildflower Centre, Liverpool, UK

In the UK we have probably have one of the longest traditions of ecological recording. However, by and large for many species and habitats we have done little more than plot their decline- without much evidence of any reverse in these observations. In turn over 90% of biological records are never looked at once recorded. Society's priority should therefore rest- especially at a time of climate change look towards practical project work that actually addresses the opportunity of reversing decline, rather than being defensive, it has to operate in a responsive way- and deliver perceivable benefits. It requires creative thinking and creative action. In this way creative conservation/ecological restoration are likely to become significantly more important in the near future, particularly to address the impacts of an increasingly urbanised and populated world. Ecology has to be presented in these places in a bold and imaginative way.

The Leaning Tower of Pisa: The placing of the first stone for the construction of the famous Tower occurred on 9th August 1173. By March 15 1298, the first commission of entrusted experts was already facing the task of "the Tower Emergency". Since then there have been 17 committees of experts called to deal with the mysteries of the bell tower of Pisa and w its inclination. In 1990 the tower's movement, of roughly 1 millimetre per year, had brought it to the brink of collapse and made it unsafe for tourists. The last committee, was installed the day after the closing of the Tower, on the day of the Epiphany in 1990.

It was only at this time a solution and a very effective solution was actioned. After 800 years engineers have finally moved it back 45 centimetre (17 inches) and got it stable. Part of the problem in the history of solving the problem was that no one wanted to be on the committee that actioned a mistake and a fallen tower- a recipe for procrastination if ever there was one.

This example shows that there may be a dogged determination to let it be unless there is imminent disaster. This reflects much that is in evidence with the conservation movement. An inability in policy and decision making to accept the fluidity of nature. We have been very good at mapping species to extinction with a reluctance to react positively for fear of upsetting these maps. There may be a reluctance to do the sensible thing because of fear of change.

As in many enterprises in business, art, design, architecture some of the most exciting and best solutions develop out of risk, like the hand in a game of poker, or the throw of the dice there may be an element of luck. Our prescriptions to the landscape can easily become moribund as we establish masterplans, action plans natural areas and character maps.

As we look to the future we need to be aware of a need for flexibility, and the recognition that this is healthy. We need to be cautious about following tight prescriptions of National Vegetation Classifications, while not savouring the time to observe the evolutionary dance of nature before our eyes.

Work by Landlife in council estates in Knowsley on the edge of Liverpool where care has been taken to ensure a good starting point and simple sowing of species have built diverse wildflower landscape of national note in a comparatively short time. It is such places that offer hope and show a balance between the helping hand- perhaps loading the dice a little, but above all giving nature a chance to do its best.

It is by involving people to these processes of change and transformation that offers the most in terms of environmental education and environmental justice. This is creative conservation working adaptively with circumstance and resources. Nature is about opportunity, nature is about change. It is the wildcard, the surprise, and the delight. Conservation should be about responding to change and should also be about celebrating the fact.

I suggest highlighting of groups/individuals who are grasping the potential of working at scale, and already impacting on society. Notable projects are those that capture the public imagination i.e. the Eden project in Cornwall, which actively seek a broad range of connections and operate in the public realm- direct contact with members of the general public as well as broad cross sections of science and the media.

Biodiversity witchcraft

Ferdinando Boero, University of Lecce, Italy

Red tides are an important expression of biodiversity, albeit negative. Dinoflagellates, responsible for red tides, produce resting stages, the inoculum of future blooms. It is highly probable that the meiofauna (small animals that live in the interstices of sand grains) feeds on the resting stages of dinoflagellates, buffering their impact on our health and our economy (red tides kill the animals we eat, can kill us, and can make shores less attractive to tourism). A proper management of the meiofauna might reduce the impact of red tides. Chances are good that we need to protect tardigrades, loriciferans, nematodes, copepods, gastrotrichs, kinorhynchs. Of course by protecting their habitat. Our understanding of functional relationships in ecosystem functioning are still primitive (the hypothesis on the control of meiofauna over plankton dynamics has never been tested, and the plankton pulse is the larger ecological event of the whole biosphere). I concur with the need of collaboration, I am the one who wrote about the need of compromise. But we need to understand how these systems work, if we want to manage them in an effective way. I do not say that it is a precondition and that we can do nothing before we understand everything. Let me say, however, that good medicine (the treatment) became possible only when we understood the structure and function of our body (the treated object). Of course we started to cure our body even before the refinement of anatomy and physiology. We did it with witchcraft, and we are possibly at that stage now with biodiversity. Many of the drugs we use today derive from those used while performing witchcraft, so there is nothing wrong with that. Surely we can do better, and we need common efforts to reach this goal, while respecting the expertise of all the actors in this very complicate play.

The EU is enforcing the ecosystem approach. I have the impression, however, that this does not go so far enough to consider the importance of meiofauna in the control of plankton pulses. I am not speaking about pandas and dolphins, about rare species and so on. I am speaking, I want to repeat it, about the most important ecological phenomenon of the whole planet both in term of oxygen production and of carbon dioxide consumption, not to speak about the biomass we extract in form of fish (deriving from the primary and secondary production expressed by plankton).

Summary of research priorities identified in Week 2

Juliette Young, CEH Banchory, UK

Research priorities identified in Week 2 of this session include:
      1. Species and habitat status and trends:
- The development of data and indicators to document biodiversity loss for ecosystem functions and ecological resilience. Existing examples cited by participants include coral reef indexes of biotic integrity (IBI) to monitor and assess the ecological aspects of marine biodiversity loss and biocriteria to regulate marine water quality; and work on the European Crayfish.
- Promote the use of existing tools (Natura 2000 for the community-ecosystem level and Red List for the species level) as indicators of biodiversity trends.
- Promote research on understanding of relationships in ecosystem functioning.
- The development of a concerted action to conserve and promote EU taxonomic expertise.
- Taxonomic data is often highly fragmented and de facto not available to users other than researchers working in large taxonomic facilities. Recommendations to counter this problem include collaborative tools on the web ("Cybertaxonomy") or web-based virtual libraries. This compilation of existing data could also help to bridge gaps among scientific fields.
- This requires, as a first step, the refinement of concepts and methods of delimitation of species and habitats.
      2. Drivers of biodiversity change:
- More research is required on the links between biodiversity/habitat loss and demonstrated loss/degradation of ecosystem services.
      3. Biodiversity management:
- Increased research on the impact of the Habitats Directive in the marine environment: is it currently the right tool, and if not how can weaknesses be addressed at EU and national levels?
- In light of global change, research on how to best integrate environmental change into conservation planning and how best to incorporate landscape and land-use dynamics into habitat management options to guarantee survival of biodiversity.
      4. Linking research with policy
- Improve the link between monitoring data and legal and other measures to address species extinction.
- Investigate the role of environmental ethics in communicating the current risks to biodiversity.
- Further develop mechanisms to promote interdisciplinary research between ecological, social and economic disciplines, as well as planning and design disciplines.
- Develop tools to improve communication of the links between biodiversity and ecosystem services to stakeholders.
- Develop methods to increased cooperation and communication between conservation scientists, decision-makers and citizens through, for example, extending the role of conservation scientists in reviews and evaluations of the EU's biodiversity conservation work.
- Increased research on the understanding of public attitudes and views on biodiversity and biodiversity management to develop and present arguments for a

comprehensive approach for ecological outcomes that are both socially and environmentally effective.

- Research to understand how the link between ecological science and decision-making science and practice can be made. This calls for a fundamentally different model of knowledge transfer: from a linear to a network model, in which scientists learn from application and learn how to insert local knowledge into their generic tools.

Improving the European science-policy interface for biodiversity governance by coordinating stakeholders processes in European research

Sybille van den Hove, Median SCP and Institute for Environmental Science and Technology (ICTA) – Autonomous University of Barcelona, Spain

Summary: Designing and implementing coordination of EU-level stakeholders engagement processes in EU research projects and networks could contribute to strengthening the European science-policy interface for biodiversity governance.

One of the 10 key policy objectives of the Communication from the Commission on "Halting the Loss of Biodiversity by 2010 – and beyond" is: "To substantially strengthen the knowledge base for conservation and sustainable use of biodiversity, in the EU and globally" (Objective 10). According to the Communication, this requires in particular "strengthening […] the science-policy interface". In the Annex 1 to the Communication, Action A10.1.8 calls for putting "institutional arrangements in place to ensure [that] policy-relevant research [is] done (e.g., in support of implementation of the nature directives, integration of biodiversity into sectoral policies) and research outcomes are reflected where appropriate in policy development." (EC 2006)

The EU science-policy interface for biodiversity governance is not a single process or mechanism, rather it is a conjunction of a multitude of interface processes happening at the intersection between science and policy, at different levels. (van den Hove 2007). Important amongst these multiple interfaces are the processes put in place by individual EU-funded projects and networks. Taking FP6 as an example, many of the biodiversity and ecosystems research projects or networks are putting serious efforts into the development of interface mechanisms with the objective of ensuring the policy relevance of their research and appropriate integration of their knowledge in policy development. Examples with which I am familiar are the HERMES and ALARM integrated projects, the AlterNet, Marbef and EDIT networks of excellence, and the Rubicode concerted action.

Key to the development of such interfaces, are stakeholders processes implemented by those projects. They range from local to EU level and take a variety of form, depending on the specific objectives of the stakeholder interaction. But they do constitute one important type of interface with policy as stakeholders include policy-makers and administrators but also all sorts of users of biodiversity research results which ultimately have a role to play in biodiversity policy and management.

If we want to improve the EU-level science-policy interfaces for biodiversity governance, we might consider the option of improving the coordination of those stakeholder processes which happen at the EU level. The key argument for such coordination is that EU-level stakeholders (policy-makers in particular) will simply not have the time and resources to participate to every single EU-level stakeholder process that individual projects organise. On a series of key policy issues, they need dialogue and knowledge of a more synthetic nature. This is not to say of course that all stakeholder interactions of all biodiversity research projects should be integrated in some sort of top-down approach. First, there might be specific policy issues at EU-level which require specific interactions. And second, the lower level stakeholder interactions must remain specific because of the intrinsic local dimension of biodiversity challenges. Maintaining fertile stakeholder processes at lower levels and

allowing genuine bottom-up processes to enrich the higher level interfaces is a necessary requirement for effective and pertinent EU-level interfaces.

The question is how to design and implement such EU level coordination mechanism. In practice, a first step towards coordination could come from the projects and networks themselves. In particular, networks of excellence could have a key role to play. But such approach also needs support and commitment on the part of the European Commission, in particular DG Research and DG Environment. As regards design, partners in existing and previous EU-funded projects and networks certainly have valuable insight to share.

How does research contribute to halting biodiversity loss?

Ben Delbaere, ECNC – European Centre for Nature Conservation

Halting the loss of biodiversity by 2010 is a target that has been agreed at high political levels. Such a political target is the result of years of lobby by a range of stakeholders, a construct of consensus. Research has played a role in this target setting, although this may have been minor compared to other sectors.

The last few decades have yielded an enormous amount of basic and applied research results that increasingly help us understand what biodiversity means to us, human beings, and our survival. Still, much is unknown and scientists and policymakers call for more research to be undertaken. A recent survey has demonstrated this for the UK (Sutherland et al., 2006) and no doubt the same is true for other EU countries. Also the EC formulates and refines policy priorities for which further research is needed. The action list in this year's EU Communication 'Halting the loss of biodiversity by 2010 … and beyond' provides good reference for the current policy needs with respect to biodiversity.

A bottleneck remains the way in which research feeds into policy and how it contributes to achieving policy targets. To scientists working on a specific subject it is already hard enough to keep up to date with progressing scientific knowledge, so how on earth can one expect policymakers, usually dealing with the broader picture, to know what is happening in science.

An answer to this, in my view, is by creating a package of tools that help policymakers get access to research results to make their decisions, as currently is done for example in the ALTER-Net. Many tools exist, but they are scattered over many institutes and sources and not coordinated or centrally accessible. An example of one component that forms part of a broader knowledge management system is the 'Science for Environment' news alert that digests research findings into short messages for non-experts. Another approach of digested outcomes – forming an evidence base - is advocated for conservation management (Sutherland et al, 2004).

However, tools alone will not be sufficient. Direct and continuous dialogue with those making decisions is a precondition for success. A range of ideas has been proposed (e.g. NERC et al, 2006; NERC, 2006; RMNO, 2005) to enable research results to contribute to policy processes – and therefore to contribute to achieving policy targets – at all levels. Although there is much to say for – for example – incorporating communication training in scientific curricula, I would especially advocate the idea to have research ambassadors that have good access to, say, parliamentarians. Professional communicators, who summarize research findings and communicate these to the appropriate decision makers.

To stimulate the debate in this e-conference I'd like to end with a concrete suggestion, based on what we have available today. I think it would be very useful to create an on-line database (to be included in the EC CHM, for example) that contains relationships between policy needs (e.g. those contained in the action list of the above mentioned EU Communication) and existing research results (e.g. those produced by EU-funded research projects). An element of this is currently being built in the ALTER-Net network; end a fuller version would indeed substantially strengthen the ERA-wide knowledge base for conservation and sustainable use of biodiversity.

What research priorities are missing?

Allan Watt, CEH Banchory, UK

I am very surprised that nobody has responded to the contribution by Mikael Hildén and Eeva Furman, particularly the quote from Sir John Lawton that "conservation is not about science". Wikipedia defines science as "Science in the broadest sense refers to any system of knowledge attained by verifiable means. In a more restricted sense, science refers to a system of acquiring knowledge based on empiricism, experimentation, and methodological naturalism, as well as to the organized body of knowledge humans have gained by such research." I therefore disagree with Lawton, as, presumably, do all of you that have not commented on the quote. However, Lawton, who has done a fair bit of science in his time, was perhaps trying to make us focus on the type of science that makes a difference to, in this instance, conservation.

In the last two weeks, many potential priorities have been discussed but others seem to have been ignored. For example:

On species and habitat status and trends:
- Population ecology of threatened species including research on minimum viable population size and area.
- Genetic diversity of threatened species.

On the values of biodiversity:
- Interactions between biological diversity and ecosystem function.
- Valuation of ecosystem goods and services and their contribution to livelihoods.
- The role of biodiversity on health and disease incidence.

On the drivers of biodiversity change:
- Impacts of harvesting and other potentially unsustainable practices on ecosystems and their functioning.
- The roles of public beliefs, perceptions and attitudes in biodiversity loss.

On biodiversity management:
- The development of ecological networks
- Reintroduction of species and restoration of habitats
- Conflict management
- Sustainable use of ecosystem goods and services

On linking research with policy:
- Evaluating the effectiveness of existing conservation policies and the impact of policies from agriculture and other sectors
- Development of new policies to halt and restore biodiversity loss.

Are these research priorities or not? And have we forgotten anything else that is important? Finally, regarding research on the drivers of biodiversity loss, the discussion has been useful but has not produced a list of priority drivers that require particular attention.

RE: What research priorities are missing?

Robert Kenward, Fellow of the Centre for Ecology & Hydrology.

Our topics are on reaching the 2010 target, urban biodiversity and on youth and biodiversity. Allan Watt notes that we have not addressed a lot of the existing

biodiversity research priorities. In fact, 11 of the 13 left can be addressed in an integrated way for our topics, with thinking that comes from work in the Sustainable Use Specialist Group of IUCN.

Biodiversity is an aspect of land use. We can seek to preserve it by protecting areas where reduced pressures of development have allowed it to remain, as in the Natura 2000 sites. We can also work on it in the more developed majority of the land, including urban areas (fide Irina Herzon). How do we stop loss? Not by protecting everywhere, because people need land for producing food and other materials. The need for human living spaces and new crops (bio-fuels!) is going to continue to change land and cause local loss of biodiversity to continue.

How do you stop a ship fastest? Not by turning off the engine but by putting it into reverse. We badly need to start restoring lost biodiversity where we can, using existing and new knowledge and resources, to offset continuing losses. How do we afford it? By exploiting its value, in order to compensate de-intensified land use and perhaps increase employment. Some de-intensification can be public-funded, e.g. to manage water and help maintain air quality. These important ecosystem functions require some biodiversity, and incidentally support other species, but not as much as is possible if we also tap private funding.

Many recreations need de-intensification. Some people value full biodiversity for observing (e.g. wildlife watching), some require enough merely to produce wild foods (berries, fungi, fish, pheasants) and some merely require access areas (for running, riding, dog-walking) in which biodiversity can be encouraged. In the United States, the latest survey estimated annual spending of 108 billion dollars on fishing, hunting and watching wildlife. Indications are that in Europe, as in the USA, spending is about a thousand Euros per person involved.

The challenge is to tap human resources from all these activities to finance subtle de-intensification measures and implement the sustainable-use mantra "what pays, stays". Such resources need not be financial, because time is money, as volunteer groups show so well. Of course, any consumptive use must be sustainable, for trampling as well as harvests. That requires science. How to maintain viable species populations with large enough patches or connectivity requires science too. Balancing optimally the competing and conflicting requirements of different human and species assemblages also needs research. As does the discovery of policies that best empower appropriate actions by local people and use their knowledge for adaptive management.

An FP6 project on Governance and Ecosystem Management for Conservation of Biodiversity (GEM-CON-BIO) started this year, with 6 of 9 partners linked to IUCN, to study how existing policies have affected biodiversity in single study sites, multi-site studies and across Europe. It will also start recording the values gained from various uses of wild resources.

The questions about how best to maximise Euros from use, and how to maximise biodiversity from Euros, also need addressing, as do those of the long-term sustainability of human effort to conserve biodiversity. How do young people become interested enough to pay for biodiversity when they are older? Is it in school, or perhaps beforehand, from family? How much does it matter that Dad took you fishing, or Mum to pick wildflowers? Is that even permitted still in your country or are we unwittingly causing loss of interest in biodiversity, just as we unwittingly lost so much of it? How did you become interested in biodiversity?

Research needs related to management practices

Francisco Pugnaire, EEZA, Almerma, Spain

Hildén and Furman made a nice and balanced contribution on research needs, and I think also that the discussion should include people not directly related to biodiversity research or management. I would agree with Lawton in that the basic of biodiversity loss may be well known, and that the emphasis should be on policy rather than research. However research is needed to properly apply management techniques. In 2000, Sala et al. published a paper on global biodiversity scenarios for 2100 in which they analysed the major drivers of biodiversity change at the global scale: changes in land use, climate, nitrogen deposition, atmospheric concentration of carbon dioxide, and biotic exchange. They concluded that actions to mitigate the human effects on biodiversity should occur at two scales: reducing the rate of change of the drivers and producing management practices carefully tailored to take into account the ecological, social, and economic characteristics of each region.

Thus both Lawton and Allan Watt, who pointed in his message to several research priorities, could be right. I guess, however, that strictly needed for conservation purposes is research related to management practices. Surely, the more knowledge we have about ecosystem functioning, genetic structure of populations, or population dynamics of rare species the better management plans we can establish, but basic knowledge to address these problems may be already available.

Two more research priorities

Larissa Khanina, Institute of Mathematical Problems in Biology of RAS, Pushchino, Russia

I agree with Allan Watt's proposal to denote research priorities in biodiversity conservation. In addition to the mentioned above, I would like to input the following research priorities:

On the values of biodiversity:
- Interaction between biological diversity and ecosystem productivity.

On biodiversity management:
- Definition of present losses of species diversity and restoration of ecosystems.
- Selection of reference sites.

Supporting policy needs to estimate favourable conservation status of habitats

Katalin Török, Institute of Ecology and Botany of HAS, Hungary

The research needs to support the European Commission communication (2006) Action plan priorities have been mentioned by several authors. However, when it comes to real data, there are major difficulties in answering questions, like how to define unfavourable status? (see Annex 2, indicators). According to the evaluation matrix of Annex I Habitat Type reporting of the EU Habitat Directive, the estimation of the range of the relevant biogeographic region, the area of the habitat type, the state of specific structures and functions, future prospects and overall assessment of the conservation status have to be assessed.

This matrix advises limits of bad condition: a loss or decrease of range or area of more than 6% per 6 years reporting period (or 1% yearly). More than 15% of unfavourable area (with significant deterioration) results in the classification of bad condition of the habitat. These are arbitrary values, that are unlikely to be valid for all habitat types: some are more dynamic, or have higher resilience than others. However, the suggested benchmarks help as a step forward. The weakest point of the state estimation is the identification of the unfavourable area, the determination of 'significant deterioration' of the habitat. The typical species of the habitat can have a major role in this process, but no guidance has been given so far.

Empirical systems exist to estimate naturalness of plant communities by giving weight to species, like typical species. The share of natural constituents (these, or part of this group can be called typical species), rare specialists and weeds is the basis for classification of habitat naturalness categories in a 1-5 system, applied in the Hungarian Vegetation Mapping Programme (MÉTA, www.novenyzetiterkep.hu/meta/en/index.shtml). Within this system, significant deterioration can be linked to rank 3, when natural constituents of the community are still present, rare specialist occur only accidentally, and there is an important abundance of weed species. Such evaluation systems should be urgently tested to help reporting: the first report is due in 2007.

Indicators of achievement of the 2010 Target

Jorge Soberon, University of Kansas, USA

In a recent presentation to the Global Biodiversity Information Network (GBIF, www.gbif.org) we (Jorge Soberon and Townsend Peterson of the Biodiversity Research Center of the University of Kansas) argued that a major asset to report losses of biodiversity can be found in the databases that GBIF has made accessible. GBIF provide primary biodiversity data in the order of 100,000,000 records. About 50% of the data is georeferenced to coordinates, and although most of the providers are institutions in the developed world (many in Europe), it does provide hundreds of thousands of records in developing countries. For example, Ecuador, Papua New Guinea, Peru, Nicaragua, Bolivia and Swaziland all have more than 100,000 records provided by GBIF. This data can be used to estimate species distributions based on presence-only methods, using widely available software (Maxent, GARP, Bioclim and others) and such distributions can be "reduced" based on land-use remote sensing information. This allows the obtention of straightforward indices (km2 of area-of distribution loss), calculated with primary data, publicly available via GBIF, and scalable to regions, countries, and even sometimes regions within countries. The basic skills and training required to use the methods can be taught in short courses, like the ones GBIF has supported for the last two years.

All of the above constitute a major effort in making taxonomic knowledge available, in capacity building and in technology transfer to developing countries. We perceive a lack of awareness about the amount and the importance of this effort, which is truly collaborative in nature and in which Europe is taking a major part. We would like to help making the wider community aware of what GBIF means in terms of its huge potential to allow countries (mainly developing) to develop their own estimators of biodiversity loss, and therefore, of compliance with the 2010 target.

2010 indicators for overall biodiversity

Dan Faith, Australian Museum, Sydney, Australia

Jorge Soberon made a very useful, important point - that a major asset to report losses of biodiversity can be found in the GBIF databases. His posting also suggested to me an interesting contrast with other postings on the same day. These highlighted the vast amount of still-unknown biodiversity, and the implied need to somehow take this "overall biodiversity" into account in addressing 2010. This raises research issues – and points to the even greater potential importance of GBIF data to address the 2010 target.

First, note some limitations of the basic process outlined by Jorge Soberon. This process would accumulate many distribution models of individual species for a given region, and calculate total losses for corresponding losses of intact land. This is a useful process, but will not help as much as we would like in estimating losses in overall biodiversity. Based on accumulated individual models the change in total would be highly dependent on the biases in sampling of taxa – e.g. the answer might change a lot if we double the number of available butterflies and neglect to model the

plants (of course, the extent of bias in particular cases is hard to quantify and more research is needed on utility of taxonomic surrogates).

In contrast, we use GBIF and similar data in a way that attempts to address overall biodiversity (Ferrier et al, 2004; Faith et al 2004; see my earlier "systematic conservation planning" posting which described a process which "addresses 'overall biodiversity' through effective use of biotic (e.g. museum collections) and environmental data to form a best-possible surrogates 'calculus'". GBIF and similar data, when combined in this way with extensive environmental data, has the potential to provide the measures of overall biodiversity required for assessments against the 2010 target. Research is needed to explore these emerging links from GBIF data to useful estimates of changes in overall biodiversity - but initial estimation of overall biodiversity patterns/changes also can begin now, using available GBIF and environmental data.

An additional advantage provided by a calculus of overall biodiversity is that it allows, not just monitoring, but also the information needed for strategic planning and implementation of a whole range of integrated conservation strategies. In this way, we may be able to not only produce a biodiversity "report card", but also ensure that the card ultimately reports success, not failure, in addressing the 2010 biodiversity target.

Service Providing Units

Richard Harrington, Rothamsted Research, UK

I was away last week and so the number of emails waiting was even bigger than usual! I have now caught up with the interesting contributions to this conference. There has been some (but not as much as I expected) discussion on impacts of various changes on ecosystem service provision by biodiversity. The new EU Co-ordination Action, RUBICODE (Rationalising Biodiversity Conservation in Dynamic Ecosystems)(www.rubicode.net) is tackling this issue partly by using the concept of the Service Providing Unit (SPU) as a definition of a population. This draws on an idea launched by Luck et al. (2003). In short, instead of defining a population according to, for example, geographic, demographic or genetic criteria, it is defined directly in terms of service provision at a given scale. For example, an SPU might comprise all those organisms contributing to pollination of a single orchard, or all those organisms contributing to water purification in a given catchment area.

Abundance, diversity (species and genetic) and distribution (spatial and temporal) are important features of SPUs in determining the level and resilience of service provision. The impact of various changes on an SPU can be translated directly into impacts on service provision. That's the theory. Adequate service provision is lost before extinction of the species comprising the SPU. In my work package we will be trying to define SPUs in terms of effect traits (that determine their ability to provide the service) and response traits (that determine their response to change). The degree of overlap of these trait sets will be a major determinant of the impact of change on service provision. In consultation with stakeholders, and using existing literature and data, we will be building `proof of concept' case studies for a range of MEA service types at a range of scales in a range of ecosystems. A workshop scheduled for February 2008 in Sweden will focus on ecosystem services, dynamics and drivers of biodiversity change. Watch the website if interested.

Mauro Agnoletti, University of Florence, Italy

According to a survey carried out in Tuscany (Italy), from 1830 to 2004, more than 40% of the biodiversity connected to land uses has been lost. These surveys mostly monitor the loss of diversity of natural species, while here we have many species that have been introduced for farming and forest activities in the last 2000-3000 years, creating complex landscape mosaics often made of 60-70 types of land uses organized in 600-700 patches in 1000 hectares. This diversity has largely been lost due not only to socio-economic trends, but also to inappropriate policies including those related to nature conservation and biodiversity. For the region of Tuscany this has led to the production of new guidelines for the conservation of landscapes in protected areas (including Natura 2000) and the development of a specific monitoring system including the monitoring of the current state of the environment showing the constant degradation of landscape diversity, and the excessive increase of forested land. Unfortunately the fixed list of habitats of the EU directive and the current idea of "fragmentation" of habitats negatively affecting biodiversity, already transferred into a regional law, is creating several problem for the active conservation of biodiversity at the landscape level.

The same problem has been noted at the national level. The current National Plan for Rural Development has established a Commission for landscape that has created a report on current knowledge and indicated actions to be financed. This document has highlighted the same kind of difficulties at national level, and also the problem of habitats (Natura 2000) described according to phyto-sociological approaches, not reflecting the human origin of the sites. For example protected areas created to save habitats described as "Oak forests" or "Beech forests", not really in any danger, but resulting from secondary successions on former pastures, fields, terraces, makes restoration of landscape diversity now impossible by law. Moreover, the actions proposed are actually in open contradiction with the actions proposed for forests and biodiversity, although a consensus seems to exist on the need to save the remaining open spaces as pasturelands.

Halting biodiversity loss by 2010: two sides of one coin

Peter Veen, Royal Dutch Society for Nature Conservation

1. In recent discussions several remarks were made about the need to connect biodiversity conservation and society. This might be correct, however what we mean is the political field in which decisions are made concerning 'landscape development' (Ortmann). Politics and biodiversity conservation are a total different matter. Politics are not based on serious data like biodiversity data but on political priorities like providing more income and more work. This means that making connections between politics and biodiversity conservation is a complicated matter. I see no solution to solve this 'antagonism' between both at this stage. Maybe we have to ask the (European) politicians themselves what kind of commitment there is (or could be) between their policy and biodiversity conservation.

2. Agriculture is the strongest player in terms of land use in Europe: 77% of the land is used by agriculture (EU COM(2005), 304 final). Only 12-13% of this area is included in the Natura 2000 network in the EU Member States (conclusion: we cannot evaluate biodiversity loss based only on Natura 2000 sites). This means that the impact of agriculture on biodiversity conservation has to be a first priority in biodiversity conservation research. We see that much attention has been given to the preparation of (mostly theoretical-based) indicators for assessment of impacts by agricultural practices (several projects in the 5th and 6th FP, Malahide indicators, Irena project by EEA and others). We urgently need results on the real connections between agriculture and biodiversity. Mostly, we work with old references like 'Ellenberg' from the sixties. My proposal is to start a European wide research for key agricultural activities within habitats of European importance (in- and outside Natura 2000 sites). Based on these outcomes, models for land use scenarios can be validated in terms of changes in nutrient households and others. Sustainable landuse and dynamic landscapes are at the moment too soft terms in my opinion.

RE: Halting biodiversity loss by 2010: two sides of one coin

Helena Freitas, University of Coimbra, Portugal

I have to confess that I have not read most of the messages but I got this particular one and I would like to support the key role of agriculture - within and outside the Natura 2000 sites - to prevent biodiversity loss. We have ongoing agriculture and forestry activities both in the Natura 2000 sites and in EU protected areas (probably with less impact but not always so) and our capacity to advise the best practices in relation to the preservation of the known values will be critical to prevent habitat and species loss. This should also involve capacity to provide scientific knowledge to support local management plans and overall policies linking agriculture interests and biodiversity conservation.

RE: Halting biodiversity loss by 2010: two sides of one coin

Marcus Walsh, BirdLife International Forest Task Force

Many thanks to all who have given time to this debate. In the footsteps of my colleague Peter Veen, a few points on the biodiversity preservation challenge from the perspective of a conservationist:

1) As noted elsewhere, the vast majority of conservation science sees no practical use in advocacy - or is never put in such a form as to be useful. Although conservation in practice needs much more than science, science and sound facts remain the foundation of all serious advocacy, without which conservation efforts usually fall flat. An example of vital science is metapopulation ecology, where enhanced understanding of extinction mechanisms in the landscape has had an immense influence on advocacy - especially as some of the field's leading thinkers have taken the trouble to pass on their knowledge to advocates (see e.g. Hanski 2004).

Suggested Driving Force #1: Important conservation initiatives arise when scientists and conservation advocates meet more often over research needs and information exchange.

2) The biggest bottleneck in conservation is the advocacy, not the science. Scientists attempting conservation advocacy "on the side" tend to be quickly disillusioned in the political world of irrational arguments, lack of interest in facts - and the sheer long term commitment needed to achieve anything lasting. There simply isn't enough time. Civil servants and researchers in environmental echelons of government can be important advocates, but if their superiors ignore their recommendations, they can do little to voice displeasure, and are indeed frequently afraid to or banned from doing so. Most NGOs are smallish, and largely full of young volunteers or professionals in their first post-college job. They usually leave after a few years just when they are starting to get good at their work. Some larger international NGOs are more concerned with their own image and PR that co-operating for the good of all.

Suggested driving force #2: the weakness of the conservation advocacy sector. All those involved need to co-operate much better. NGOs must find ways to grow larger and more professional.

Suggested driving force #3: Ignorance. It is easy for scientists to forget just how little e.g. farmers or forest owners know about conservation of biodiversity. Often the advice they get from consultants and owner unions is not at all helpful in this regard. Landowners are increasingly willing to take up conservation-oriented schemes, but there are precious few out there with the wherewithal and skills to reach large numbers of them. How to solve this?

Suggested driving force #4: industry, not governments, and especially the agriculture and forestry industries, will decide the fate of the world's natural and semi-natural grasslands and forests. We must help them accept this, and show how they can become proud guardians and supporters of the world's last orangutans, tigers, and rare ecosystems generally. Utopia? It is the only hope.

Small eco-enterprises

Liz Hopkins, Fauna and Flora International, UK

There is an apparently growing sector of pro-biodiversity small enterprises (or eco-enterprises) in Europe. The Probioprise FP6 project has defined eco-enterprises as: "those enterprises which are dependent on biodiversity for their core business and seek to conserve or restore it in the course of their economic activities". We know little of the size or scale of the sector because it is almost invisible in official statistics.

The activities of such companies range from primary production, through transformation of primary products, non-consumptive use and parallel services, often more than one of these in one company. In terms of ecosystem services (Millennium Ecosystem Assessment WRI 2005), there are markets or quasi-markets for Provisioning Services, Cultural Services and for climate regulation under Regulating Services.

The project is meeting and listening to the companies themselves, so it is empirical in its approach. It will produce a research programme towards the middle of 2007 (to which those who are interested are welcome to contribute). There are a range of emerging research topics most of which will combine biodiversity, economic and social/cultural issues. We have found that most small eco-enterprises navigate between these domains, offering products and services within them (e.g. production of rare fruits and vegetables combined with education programmes) in order to achieve economic viability but also often on the basis of their owners' or managers' convictions.

In light of the discussions at this forum some questions: What policy measures will support eco-enterprises and encourage biodiversity-friendly innovation? How should the biodiversity performance of companies be monitored? What kind of biodiversity information should be delivered to small companies and especially to government officials who deal with them? How can conservation scientists and economists formulate their findings to be of help to small businesses and also to develop new business ideas which meet biodiversity conservation or restoration needs? How can the delivery of public biodiversity goods by companies be quantified and paid for?

The owners and managers of such enterprises are often extremely knowledgeable especially about their local biodiversity and its management. They also tend to be strongly motivated individuals. Their contribution to the 2010 target could be (and probably already is) significant. Business and conservation expertise have joined together in the Probioprise project which, in itself, promises new players and a new research agenda up to 2010 and beyond.

RE: Small eco-enterprises

Nuno Oliveira, AmBioDiv ~ Valor Natural, Portugal

My name is Nuno Oliveira and I'm a conservation biologist from the Faculty of Sciences, Lisbon University. In 2005 I launched a start-up company called AmBioDiv ~ Natural Value, derived from the Portuguese words for Environment (Ambiente) and Biodiversity (Biodiversidade). The purpose of this endeavour was to develop for-

profit business models concerning conservation biology, natural resources management and environmental engineering.

As a consultancy company dedicated to conservation biology, ecological engineering, environmental management and sustainable development, our main goal is to include the issues on biodiversity and habitat management in the business agendas of the following key sectors operating in Portugal: Agriculture, Forestry, Tourism, Mining and Stone Extraction and Energy Production. The AmBioDiv Portfolio already includes the initial implementation of Conservation Action Plans in two different types of farms: one operating in an extensive organic farming model, with 1200 ha of 'Montado' (*Quercus suber* - cork oak ecosystem, included in the Habitats Directive) and in large intensive farming facilities, mainly dedicated to salad and watercress production. In both cases, biodiversity trend monitors and conservation guidelines are being tested and implemented on the ground. These should help to promote the 2010 Countdown targets. These projects are being started exclusively with private funds provided by the farm owners, thus demonstrating that there are possibilities to incentive private investment in nature conservancy. It seems to us that this is one of many ways to comply with the UN and EU goals on Nature Conservancy and Sustainable Development.

As you know, this is a trans-disciplinary work which involves biologists, engineers, managers etc. As such, we have all the best interest in the harmonization of the best practices guidelines that allow each element to put its best contribution on the table, with highly efficient results for the clients and promoters. One of our main problems as a start-up in a (almost completely) new business area in Portugal is that most of the projects involving these issues are disregarded as being 'non-essential to business activity', or as environmental/social marketing only. This leads to considerable problems involving the absence of business perspective and the enormous difficulties that we experience when approaching some companies, regardless of their size. As an example, despite the several attempts to contact the Portuguese Business Council for Sustainable Development, there are still no signs of receptiveness.

I haven't been able to properly follow this forum, unfortunately, but this subject on eco-enterprises obviously got my attention, because from what I've read of Ms. Hopkins' contribution, we are a sort of eco-enterprise, and we are truly and deeply committed to involving the private sector in active biodiversity and ecosystem valuation projects.

Therefore, I'd like to know how the participants consider the Probioprise FP6 project in promoting sustainable development and the link between business and Nature.

Conservation biology: the need for mutual knowledge transfer

Norbert Sauberer, Vienna Institute of Nature Conservation and Analyses, Austria

Based on my experiences at the interface of conservation science and practice (I work voluntarily for a small Austrian NGO), I recognised the lack of knowledge transfer. Most people who work in nature conservation, inside and outside of protected areas, do not keep up with the growing scientific literature and expertise; they base their decisions mainly on their own experience or on what they have learned (or haven't learned!) at the university. Quite often this leads to problematic approaches. However, many practitioners have an excellent ecological knowledge and survey their study areas regularly. Sadly, the body of acquired knowledge is rarely written down and, if so, mostly in obscure reports that will never be published. So, the evidence-based conservation approach (e.g. Sutherland et. al, 2004) will increasingly gain importance in the future. Additionally, the main results of the systematic reviews must be translated into the particular mother tongue and an online discussion forum that encompasses scientists and practitioners should be established. I think this would improve biodiversity management significantly.

Finally, some words about the involvement of stakeholders and politicians: in my experience, their attentiveness for biodiversity increases with a mixture of (i) good arguments, (ii) sparking their interest with unexpected background stories, (iii) getting them involved emotionally and (iv) reminding them of their responsibility. For instance, securing and restoring ecosystem services for human well-being, e.g. reducing the flood risk with extensive semi-natural retention areas, and biodiversity conservation complement one another – this really is a good argument!

Biodiversity in forests - discussion is needed

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

Czech scientists protested against unsustainable management used in some our forests and tried to suggest ways how to maintain biodiversity there (see http://lesy.drosera.cz/?eng). We argue the following important points:
1) Elimination of clear-cutting
2) Restoration of the natural species composition
3) Retaining old trees and dead wood in the forest
4) Liming and fertilization
5) Reduction of deer populations
6) Protection of nature reserves
7) Regulation of afforestation and reforestation

This statement led to the huge refusal mostly from professional foresters maybe due to asymmetric support of mainly biological aspects at the expense of the economical ones. Further, about five next official statements appeared and the document was very discussed in media.

From another point of view. The Institute of Botany has participated in a publication (http://chm.nature.cz/cooperation/fol1362718) dealing with t how the Czech Republic could realize its engagements under the CBD. The recommendations in this book would not have been possible without the collaboration between landscape managers (e.g. foresters, people involved in conservation) and scientists.

Therefore, we decided to organize a meeting to bring all these people together again to discuss the topics mentioned above (in fact, this is a goal of the Bioplatform project). Nearly 60 people from all 30 important institutes came. The main output is now a document with defined goals for forest management broadly accepted by almost all members. However, the discussion is not over and continues in various ways including collaboration on ecological aspects of forest national strategy, meetings, e-mail correspondence etc.

I think this is a good (forest) example of how to reconcile the conflicts between various social groups. This is a concrete way in which the science can contribute to our policy. Detailed descriptions will be available at Finnish meeting.

Registering changes in biodiversity

Alan Feest, Bristol University, UK

It seems that on each of these conferences we come to many of the same questions and conclusions regarding the practical way forward in the preservation of biodiversity. Since there is no agreed way to measure changes in biodiversity a real measurement method is avoided and a surrogate method is used: indicators. This also accords with the international programmes e.g. CBD, MEA etc. Indicators have real problems such as: a) they rarely measure population strength and this could be an indicator of success/failure; b) they are rarely validated against what it is they are meant to indicate; c) they are very subject to observer bias

But, if a real way to measure biodiversity change was found could we bring about a change in the already agreed and instituted methodology?

Some indicators are able to provide much more information than the normal simple presence/absence indicator and of these the two outstanding ones are the Pollard and Yates walk based monitoring of butterfly populations and the Common Bird Census methodology pioneered by the British Trust for Ornithology. Both of these methodologies have been fully validated and tested. In my own we have shown that the butterfly data collected can provide a lot more information than that which is usually presented. Similarly I have used the principles created by Pollard and Yates to measure the biodiversity quality of a range of other organism groups e.g. macrofungi, beetles, spiders, and bryophytes. Since butterflies and birds are already being recorded in a way that allows a true measurement of biodiversity quality should one of the outcomes of this conference be a recommendation to adopt a similar recording methodology for other groups so that we can have far more confidence on biodiversity quality trends than that engendered by the current indicator approach?

Summary Final Week

Juliette Young, CEH Banchory, UK

Research priorities identified in the last week of the e-conference include:

      1. Species and habitat status and trends:
- Develop improved estimators or "surrogates" for overall (known and unknown) biodiversity.
- Develop estimates of marginal gains/losses rather than estimates of total species numbers in a given place.
- Explore how a rapid, large scale DNA barcoding program might be used for conservation planning for 2010
- Better evaluate existing scientific knowledge and integrate this knowledge with regard to particular topics or problems.
- Promote implementation and target-oriented research, which focuses on solving 'real world problems', contributes to implementation processes by being part of the process itself and integrates different kinds of knowledge in an interface that involves actors from the world of science as well as from practice.
- Develop population ecology of threatened species including research on minimum viable population size and area.
- Research on the genetic diversity of threatened species.
- Assess present losses of species diversity and restoration of ecosystems in view of selection of reference sites.

      2. Drivers of biodiversity change:
- Assess impacts of harvesting and other potentially unsustainable practices on ecosystems and their functioning.
- Assess the roles of public beliefs, perceptions and attitudes in biodiversity loss.
- Explore the potential of GBIF in allowing countries (mainly developing) to develop their own estimators of biodiversity loss, and compliance with the 2010 target.
- Develop evaluation systems for the identification of the 'unfavourable area', as well as the determination of 'significant deterioration' of the habitat (Natura 2000 sites).
- Promote research to develop adaptive measures for biodiversity and climate change in all terrestrial, coastal and marine areas within the jurisdiction of EU member states.
- Evaluate the impact of key agricultural activities on biodiversity conservation. Based on these outcomes, models for land use scenarios can be validated in terms of changes in nutrient households and others.

      3. Values of biodiversity
- Evaluate the interactions between biological diversity and ecosystem function.
- Develop methods for the valuation of biodiversity, including ecosystem goods and services and their contribution to livelihoods.
- Assess the role of biodiversity on health and disease incidence.
- Determine the interaction between biological diversity and ecosystem productivity.

      4. Biodiversity management:
- Produce realistic estimates of opportunity costs of conservation, and their distribution, including ways to combine different costs.
- Research on the development of ecological networks
- Research on the impact of the reintroduction of species and restoration of habitats
- Conflict management
- Sustainable use of ecosystem goods and services
- Research is needed to properly apply management techniques.

- Identify ways to maintain viable species populations with large enough patches or connectivity.

      5. Linking research with policy

- Develop methods to design and implement coordination of EU-level stakeholders engagement processes in EU research projects and networks
- Include trans-disciplinary work directly within projects
- Promote the establishment/adoption of appropriate administrative tool(s) to address the general and specific communication failures of conservationists/ecologists
- Assess the needs or the general public in order to adequately "market" biodiversity.
- Promote the development of a methodology which collects and synthesises the evidence in a rigorous, unbiased, repeatable and transparent way. The resulting library must be shared by the community that produces it and be open access to the users.
- Create a package of tools that specifically help policymakers get access to research results to make their decisions by coordinating existing tools and making them centrally accessible.
- Develop methods to encourage direct and continuous dialogue with decision-makers. One suggestion is to have research ambassadors that have good access to, say, parliamentarians as well as professional communicators, who summarize research findings and communicate these to the appropriate decision-makers.
- Evaluate the effectiveness of existing conservation policies and the impact of policies from agriculture and other sectors
- Develop methods to incorporate private as well as governmental actions engaging the private sector for areas like agriculture, fisheries, marine shipping, tourism alternative and renewable energy etc.
- Identify ways to promote eco-enterprises and encourage biodiversity-friendly innovation
- Develop systems to monitor the biodiversity performance of companies
- Identify methods for the quantification of delivery of public biodiversity goods by companies
- Examine the scope for the development of new policies to halt and restore biodiversity loss.

      Many thanks to all contributors to this session for your insightful contributions. All the research priorities identified in this session will be compiled and will form the basis for the EPBRS meeting in Helsinki in November.

Status, trends and research needs in urban biodiversity in Europe

Introduction to Urban ecology and biodiversity: status, trends and research needs in urban biodiversity in Europe

Jari Niemelä, Chairman of the national organizing committee, University of Helsinki, Finland

The aim of this e-conference session is to discuss status, trends and research needs in urban biodiversity in Europe. In order to launch the discussion I e-mailed these issues using the ENULE-e-mail list. Here is a summary of the replies. I hope that these prompt the readers to respond.

1. Is biodiversity increasing/decreasing in European urban areas?

Urban biodiversity is decreasing. Native species and their habitats in particular are suffering. However, some species have benefited (e.g. UK urban areas may be strongholds for birds that are declining at a wider scale). Furthermore, the increase of abandoned and derelict land in cities favours some species. Such land is important especially for plants and invertebrates. Also alien species have increased in urban areas with deleterious effects on native biodiversity. The main reasons for these changes were said to be development pressure and lack of understanding, acceptance and appreciation of urban biodiversity.

2. What are the main research questions that need to be addressed in order to better promote biodiversity in urban areas in Europe?

Several research topics were listed:

1. Development of standardized methods and indicators across Europe for comparative assessment/monitoring of urban biodiversity.
2. Functioning of urban ecosystems incorporating the human dimension.
3. Effects of habitat fragmentation and the role of urban ecological corridors.
4. Planning for biodiversity in urban areas
5. Assessing the importance of private gardens for biodiversity.
6. Urban ecological research in urban planning and design.
7. Relevance of urban green space for the urban dwellers.
8. Measures needed for halting the loss of urban biodiversity in Europe.

A suggestion was to launch an EU-wide research project using a comparative approach by conducting similar kind of field work along urban-to-rural gradients in many cities across Europe (for an example see http://www.helsinki.fi/science/globenet/). Anybody interested?

3. What are the main actions to be taken to promote biodiversity in European cities?

Several actions were suggested: Information about the importance of urban biodiversity and green/blue areas must be conveyed to decision-makers, planners, designers and the public; The development of regulations and legislation concerning urban green/blue areas; The prevention of fragmentation of natural vegetation; The increase of the quality on remaining woods and other green areas.

All this requires research because it is difficult to act without knowledge. Furthermore, it was stated that a European Urban Biodiversity Action is urgently needed.

Draft resolution on urban ecology and biodiversity: status, trends and research needs in urban biodiversity in Europe

Jari Niemelä, Chairman of the national organizing committee, University of Helsinki, Finland

As indicated in the introduction, the e-conference will feed material into the EPBRS meeting in Helsinki in November. The meeting participants will produce resolutions, one of which will be about urban ecology/biodiversity in Europe. Based on the discussions during the first week of the e-conference, and on the discussion in the ENULE-list, I have produced a draft resolution about urban ecology/biodiversity (below). I would be happy to hear your views on the draft resolution (which will be thoroughly discussed during the Helsinki meeting)

Recommendations of the meeting of the European Platform for Biodiversity Research Strategy held under the Finnish Presidency of the EU, Helsinki-Espoo, 17-19 November 2006

Status, trends and research needs on urban ecology and biodiversity in Europe

Europe is highly urbanized and some 80% of Europeans live in urban areas. Their well-being and quality of life is directly influenced by the state of the urban environment. Cities are where many environmental problems are concentrated, but they are also important economic drivers. A high quality urban environment also contributes to the priority of the renewed Lisbon Strategy to 'make Europe a more attractive place to work and invest'.

However, there are increasing concerns about the state of Europe's urban environment. In addition to the 'traditional' environmental problems of cities, such as noise and contamination of waters, air and soil, urban biodiversity is becoming an increasingly important issue for urban residents who are concerned about the future of green areas and their biological diversity in the face of growing demand on land for construction. The environmental challenges facing cities have significant consequences for human health, the quality of life of urban citizens and the economic performance of the cities. These concerns have prompted the Commission to produce a Thematic Strategy on the Urban Environment (Communication from the Commission to the Council and the European Parliament on Thematic Strategy on the Urban Environment, COM(2005) 718final).

To achieve the objectives of the Thematic Strategy on the Urban Environment and the target of halting biodiversity loss by 2010, the participants of this meeting place high priority on the following research needs in urban areas (A), the science-policy interface and communication of research results to other stakeholders (B), and to associated enabling outcomes (C).

A. Research needs

According to the meeting participants the most pressing research needs in urban areas in Europe are the following:
1. Functioning of urban ecosystems.
2. Relevance of urban green space for the urban dwellers.
3. Effects of human activities, such as habitat fragmentation, on urban ecology and biodiversity.
4. Development of standardized methods and indicators across Europe for comparative assessment and monitoring of the state and trends of urban biodiversity.
5. Integrating urban ecological research into urban planning for the maintenance of biodiversity in urban areas.

As the environmental, economic and social dimensions meet strongly in urban areas, research on urban biodiversity should be interdisciplinary and oriented towards policy and management. This would support the call for an 'integrated approach to environmental management' in urban areas presented in the Thematic Strategy on the Urban Environment1.

B. The research-policy interface and communication of research results to stakeholders

Research on urban ecology and biodiversity should be planned so as to emphasize dialogues between researchers and the implementers of the desired solutions. Efforts should be made to actively apply adaptive resource use and management practices, which will require the establishment of feedback mechanisms based on assessments of the impacts of urban development on biodiversity. Such approaches can facilitate dialogues between researchers, managers, policy-makers and citizens on urban biodiversity, while also helping to identify cost-effective and socially acceptable solutions that will safeguard biodiversity.

An active and effective research-policy interface endorses the integrated approach to environmental management based on consultation of all stakeholders presented by the Thematic Strategy on the Urban Environment. Furthermore, integrated management of the urban environment should foster sustainable land-use policies which avoid urban sprawl and reduce soil-sealing, include promotion of urban biodiversity and raise awareness for urban citizens1.

C. Enabling outcomes

1. Better coordination of urban biodiversity research is required for effective research and its impact in the society. A European Research Area for urban biodiversity needs to be established, and research capacity with interdisciplinary and participatory science strengthened. The reinforcement of the cooperation within and between learned societies, NGOs, policy makers and funding agencies is essential to build a common research agenda for the future.

2. Continuous funding of urban biodiversity research at national and European levels is essential. Urban ecological research should include interdisciplinary programmes whose results will help sound decision making. Funding should also be available for the communication of research results. The participants of this meeting strongly support the assertion in Thematic Strategy on the Urban Environment according to which the Commission will offer support for further urban research and will actively involve local authorities and endeavour to make material developed for them available in many languages to facilitate use

Understanding attitudes towards urban green spaces

Robert Home, Swiss Federal Research Institute: Forest, Snow, and Landscape (WSL)

I am currently working on a project relevant to point 7, namely to try to gain an understanding of the attitudes of residents of Swiss cities towards urban green spaces, and in particular to biodiversity. I write this by way of introduction because I would like to establish contact with those who have similar interests or experience.

I believe that such an understanding is a prerequisite for point 4, 'planning for biodiversity', which is in turn necessary for the implementation of biodiversity conservation measures in urban areas. Conservation measures, unless aligned with the interests of the residents, are unlikely to be owned, and therefore unlikely to succeed in the long term.

There is evidence, in Switzerland at least, that cities are regarded by residents as being for people. Urban green spaces are assessed in the minds of individuals according to usefulness and access, stimulation and attractiveness. An altruistic interest in the health of non-human organisms seems to be small or non-existent. If, as it seems, an anthropocentric perspective is dominant, and an alignment of interests is required for the success of conservation strategies, then the implications for ecologists are disturbing. Conservation strategies are constrained within the boundaries of human, rather than ecological, needs.

Development of strategies for broadening the boundaries of human needs, in other words for enhancing the acceptance of conservation strategies, is an area where there is much work to be done. I would argue that this 'market research' is of fundamental importance if the conservation measures are to be 'sold' to a critical public.

I see it as self-evident that such research requires ecological research to be conducted in parallel if it is to translate into practical use. The purpose of this opening is to stake the claim that the opposite is also the case.

RE: Understanding attitudes towards urban green spaces

Richard Scott, National Wildflower Centre, Liverpool, UK

In response to Roberts Homes topic, I attach a copy of a recent cabe space publication we were involved in writing with Sheffield university. This publication was particularly targeted at contract managers for local authority landscape managers and hopefully speaks for itself.

I think it important to consider actions outside biodiversity focus groups-which pushes biodiversity issues into the realm of architects and planners and beyond university departments. Often there is a lot of exciting work which happens without register of BAP frameworks- unfortunately BAP frameworks in regions are often not flexible enough to target real life tales of biodiversity action- even when they may be of national note.

For example work of Landlife on Merseyside - informing groups nationwide in the form of good working practice- in terms of applied ecology and creative conservation practice. Ironically local best project sites which are eagerly viewed

from groups both nationally and internationally have no conservation value or recognition or place to be logged on the local North Merseyside Biodiversity action plan. Nature is about opportunity but if the species are not on original LBAP lists there is no place to report these real biodiversity action events. Even species listed on as nationally important may have no recognition if the species is not included on the local biodiversity action plan list.

In this way many ideas that have come out of the realm of urban ecology have huge relevance in terms to issues like climate change and spatial ecology- in terms of where the best effort should be placed. It is also in these so-called urban ecology projects that true conversations in terms of combining community interest and ecology has a long history. In truth nature has no boundaries and these lessons are value everywhere- but sadly these lessons are often overlooked. It is notable that techniques pioneered by Landlife are now being adopted and trialled by other national groups such as the Woodland Trust.

Also of note which I would like to highlight is recent work in spatial ecology undertaken by English Nature (English Nature reports No.687: Planning for Biodiversity- opportunity Mapping and habitat networks in practice: A technical guide. Author Dr. Roger Catchpole). This is an important work bridging science and practice- and making clear the opportunity - in the past overlooked of the land that has been outside the interest of statutory conservation.

Just for interest Landlife was one of the first urban wildlife groups in the UK (wrote the first Urban Wildlife strategy for Liverpool in 1982) and founded the National Wildflower Centre on the edge of Liverpool in 2000. The history of the organisation details a journey of creative conservation action. The National Wildflower Centre is one of a handful of Millennium projects with a environmental focus- which operates at the cutting edge of the people and wildlife debate.

Public consultation work by Landlife- detailed in the attached cabe space publication shows that when done well- public response to creative conservation style project work is extraordinary. In Kirkby 97% of individuals wanting more wildflower landscapes, and significantly 64% of respondents more likely to take a walk outside. This study was also in an area of generally very low percentage response to consultations this response at 20% return.

RE: Understanding attitudes towards urban green spaces

Jari Niemelä, Chairman of the national organizing committee, University of Helsinki, Finland

I see the point by Robert Home that perhaps the research topics in the initial list that I provided are not in a logical order. It may be more logical to start with the views of people.

Psychological and aesthetic considerations

Susanna Lehvävirta, University of Helsinki, Finland

Ecological solutions for the preservation or enhancement of biodiversity in urban areas are viable only if they gain public acceptance. This is why we, here in Helsinki (Finland), are planning to link psychological and aesthetic aspects to the research of urban biodiversity. We are initiating research where both ecological and human perspectives are being tested within the same design.

Every time a new ecological idea is being considered, the sociological, psychological, aesthetic or other possible human perspectives should be incorporated into the initial research plan. Otherwise it may be that different perspectives touch upon each other only superficially, i.e. do not really speak about the same object. In such a case argumentation would be weaker than if jointly tested from both human and ecological perspectives.

RE: Psychological and aesthetic considerations

Jari Niemelä, Chairman of the national organizing committee, University of Helsinki, Finland

I agree with Susanna that (ideally) 'every time a new ecological idea is being considered, the sociological, psychological, aesthetic or other possible human perspectives should be incorporated into the initial research plan.' But establishing such a multidisciplinary research effort is very challenging, and I wonder if there are examples of successful research projects that have succeeded in such an integration.

RE: Psychological and aesthetic considerations

Jonathan Sadler, University of Birmingham, UK

We have been working for the past 4 years (here in Birmingham) on a project examining urban (re)development with an emphasis on creating sustainable futures for people and the environment. The project is now in its 4th year and has further funding for 2 more. The approach is multidisciplinary involving social scientists, ecologists, geographers, economists, political scientists and engineers. The emphasis is on sustainable design through to build and management.

Jari is correct - work like this is extremely challenging as it involves both science and social science - the methods crash into each other a lot and cause a fair bit of friction. We found that having four dedicated postdoctoral researchers based in a 'team' with a shared facility (room, computers etc) helped the integration process. We then attempted to target elements of the development process and each researcher considered this from their perspective. The aim was to examine where there was shared ground, common themes, disruptions and so on.

What struck me about this work was not only the complexity of the social elements and how they might interface with sustainability (how ever you define it) but just how much 'networking' the researchers had to do to get at the answers they were

seeking. They quite literally had to 'break into' the network of actors and players in the process before we could start to disentangle the linkages. This took 1-2 years before the team had an identity and were accepted by the groups they were engaging with. Additionally, the scientists and engineers had to embrace a whole new language and adopt methods (and writing styles) that were both unfamiliar and uncomfortable.

I think that integration requires this level of interaction and flexibility - it also takes imagination to get the ecological science into the system.

Urban biodiversity: The ET project

Susanna Lehvävirta, University of Helsinki, Finland

Many of the research topics listed by Jari Niemelä in this session are interesting. I want to inform you about a research initiative that we planned with international (EU-wide or world-wide) comparative research in mind. Our project covers, or is closely linked to, the topics 2, 4, 6, 7 and 8 listed by Jari. This serves also as an invitation to carry out joint research if you find the topics relevant.

Our project, called ET (from the words Edge and Trampling effects) concentrates on the prerequisites of preservation of indigenous fauna and flora. Fragmentation of urban green with a consequent increase in edge effect is a fact, and at least in the Nordic countries, also recreational use of the urban green is active. This is why we chose to concentrate on these topics. We already have results about soil microbial and vegetation responses to edge and trampling in medium-fertile spruce and pine forests, and a carabid data from spruce forests (papers submitted or soon-to-be-submitted). However, we do not know yet about the responses of other taxa, or other types of ecosystems. Furthermore, we do not know if people respond to these effects, whether there is be a psychological or aesthetic edge effect, for example.

The aim of the project is to produce guidelines for urban planning as well as management of the green areas. For example, based on the first results, we have suggested a minimum diameter of 150 meters for a Finnish Myrtillus-type urban woodland, in order to preserve the indigenous species of the ecosystem in urban areas. Of course this value is subject to criticism, but it serves as the best tool so far, and can be revised when new knowledge accumulates.

Do the same response patterns to edge and trampling exist in other countries? If you can name an ecosystem where edge effect or human trampling might play a role, we have a ready-made design that you could use, to make sure that your research results are then comparable to ours. Our vision is that ET could grow world-wide, and also move on to experimental work, to reveal mechanisms behind the observed patterns of ecosystem or species responses to edge and trampling.

RE: Urban biodiversity: The ET project

Jonathan Sadler, Birmingham University, UK

This is an excellent idea and we have (carabid) data from UK woodlands that show a significant trampling effect. I have (invertebrate and plant) data from other habitats as well. But some of these habitats - especially derelict sites (or brownfields) actually 'benefit' from disturbance of this nature as it slows down succession or even resets successional trajectories and creates areas (banks) of open substrate which are habitat for a range of uncommon invertebrates. The sites are aesthetically unpleasing (especially the ones frequented by youngsters on bicycles and motorbikes but they are ecological very interesting.

The question is at what level does this 'disturbance' become a negative force? Incidentally, many of these sites are very strongly tied into the local communities - they are the only open spaces available for use.

RE: Urban biodiversity: The ET project

Robbert Snep, Alterra Wageningen University Research, The Netherlands

With respect to the effects of recreation on wildlife I would like to mention a study in which colleagues of mine have developed an expert system that models the recreationists' movement through natural parks and thereby illustrates the impact area of recreation on the wildlife in these parks. The model was applied both in the Netherlands as well as in the UK, as a tool for park managers. This research was very recently presented at the third international conference on monitoring and management of visitor flows in recreational and protected areas, University of Applied Sciences, Rapperswil, Switzerland , 13-17 September 2006, and was entitled: Development of a zoning instrument for visitor management in protected areas. Henkens, R.J.H.G.; Jochem, R.; Pouwels, R.; Visschedijk, P.A.M.

A planned workshop on GLOBENET

Lyubomir Penev, PENSOFT Publishers, Sofia, Bulgaria

The idea of a PAN-European project on urban biodiversity using the methodology of "urban-rural gradient" offered by Jari in his opening message, or its development into the more detailed Edge and Trampling (ET) project is tempting and our Sofia research group, participating in GLOBENET from the very start of its establishing, is intersted in being involved in such a project.

Besides, next year (20-24 August, 2007, Blagoevgrad, Bulgaria) we plan to organise a GLOBENET workshop within the 13th European Carabidologist's Meeting, devoted to summarising the results and conclusions accumulated in several European countries, as well as some overseas ones (Canada, Japan). The URL for the workshop is: http://www.ecolab.bas.bg/ecm2007.

I believe the workshop could be extended to more general level formulating the rationale and aims of a future EU project or hopefully even to be a kind of kick-off meeting of a possible new project.

Rich urban diversity?

Norbert Hirneisen, Science4you

Last year I had attended the GEO Bioblitz in Berlin (Tiergarten) and a conference on urban biodiversity in Berlin. Recent activities in Wien (Vienna, Austria) on urban Butterfly monitoring and related projects show that urban biodiversity is often richer as expected. First, cities have a lot of different habitats - often only small spots. Next, you can motivate a lot of people to look after plants and animals so chances are good that most habitats are covered. In your standard rural environments you nowadays have the problem of intensive agriculture - only little biodiversity is left and large areas are monotonous. So I think we have better chances to look at an improving richness in biodiversity in urban areas than in rural areas (with the exception of protected areas of course).

RE: Rich urban diversity?

Robert Home, Swiss Federal Research Institute: Forest, Snow, and Landscape (WSL)

I was very pleased to read Mr Hirneisen's post. We at the Biodivercity project (www.biodivercity.ch) have a similar understanding of the potential for species richness in cities. We hope to contribute to knowledge by adding Swiss cities to the mix. However, we are not contrasting urban and rural but rather urban and peri-urban. The reason for this decision is that peri-urban regions in Switzerland are the most dynamic and therefore those where there is a large potential for application of findings.

     The project has four parts. The first was a series of stakeholder hearings to gain input of research needs and requirements. Currently underway are two parallel projects: One is to measure the existing species richness, using birds, bats, and insects (The insects with Rapid Biodiversity Assessment).The other is to measure attitudes of residents with the aim of developing strategies to enhance acceptance of biodiversity enhancement measures. The final stage of the project will be to produce a practical output in the form of spatial planning tools.

     We also agree with several of the other postings on this forum that for research to contribute to effective decision making, it must be interdisciplinary to reflect the contexts in which decisions are made.

RE: Rich urban diversity?

Robbert Snep, Alterra Wageningen University Research, The Netherlands

The BiodiverCity-project looks like a very interesting project because it combines ecological and social research directions regarding urban green and wildlife. The distinction that is made between urban and -urban areas is one I agree on, and which is also supported by the well-known curve in species richness levels: urban (low), peri-urban (high) and agricultural intermediate). Reality however is much more

complex, as discussed in: Clergeau, P., J. Jokimaki and R. Snep (in press, available online).

In addition, I look forward to hear about research projects like yours, in which research results are meant to be implemented in planning and urban green management practices. I believe that as soon as we, urban ecologists, start to better understand the urban ecosystem, and make this information available for planners, developers and (landscape) architects, it will be much easier to reach the potential values that (peri)urban areas offer for biodiversity. In the Netherlands we already try to include urban ecological insights in urban development and planning. At www.groenemetropolen.nl you'll find some examples. Next, with respect to the difference between urban and peri-urban areas, we recently explored how peri-urban areas could support biodiversity levels in urban centre (Snep et al, 2006).

Other research initiatives

Philip James, University of Salford, UK

At the University of Salford, UK the Urban Nature Research Group was established about four years ago. We are working on multi-disciplinary projects which have the common goal of providing empirical information to support decision makers in bringing about changes in the way our urban areas are designed and managed. We are currently engaged in work which asks questions about existing concepts regarding the creation and management of open space in urban areas, which asks questions about the use of these open spaces by residents from various backgrounds and which ask questions about how these issues can be communicated to all stakeholders. As such our work sits within a research space which lies within a triangle with Sustainable Communities, Life Style Choices and the Knowledge Society at its three points. Full details of our current work may be found by visiting our website: www.els.salford.ac.uk/urbannature

RE: Rich urban diversity?

Sandrine Godefroid, Vrije Universiteit Brussels, Belgium

Robbert asked for examples where research results are meant to be implemented in planning and urban green management practices. I can give you some examples for the city of Brussels. A lot of research projects are actually financed by the regional administration (Brussels Institute for Environment Management) who has in charge the ecological management of urban parks and nature reserves within the limits of the city. The aim is to involve experts from universities in the management plans of urban nature. Research projects funded by the administration are dealing with, for instance:
- Monitoring the vegetation in a network of permanent plots throughout the green spaces, in order to provide recommendations for a sustainable management
- Investigation on the effect of trampling on the vegetation development, in order to optimise public use of urban green spaces while maximising biodiversity
- Exploring the impact of fencing on the recovery of the ground flora on heavily eroded slopes in urban forest patches highly used for recreation

- Study of the effects of the path substrate (e.g. asphalt, dolomite, sand, cobblestones) in urban green spaces on the surrounding plant species composition and soil compaction, in order to chose the most environment-friendly substrate type for future management works
- Study of the functionality of corridors and stepping stones between fragmented plant populations, in order to better manage and develop the existing Green Network
- Study of the ecological factors controlling the abundance of non-native invasive species in urban forest patches, in order to be able to restore invaded sites and to avoid further invasions
- Exploring the seed-banks in urban forests, in order to identify potentials for the restoration of a degraded herb layer
- Understanding the ecological drivers of plant species richness and diversity in urban wastelands, aiming at a better management of this habitat

All these studies are requested by the managers themselves. Results are presented to them by the scientific community who is directly involved in the management decisions. Brussels works with that system (research contracts between universities and urban planners) since the beginning of the '90s, and it gives good results: native species which are endangered at regional or national level are coming back in urban spaces. Furthermore, the city has now 9 habitats of Community importance according to the Directive 92/43/EU (habitats 4030, 6430, 6510, 7220, 9130, 9150, 9160, 9190, 91E0). These are also managed in consultation with the scientific community. The website of the Brussels Institute for Environment Management (www.ibgebim.be), provides information (in English) on Brussels' biodiversity, green and blue network, Natura 2000 areas, nature management, parks and gardens, woodlands, nature reserves, etc. This can give you an idea about nature and its management in the urban ecosystem. More reading on this topic can be found at the end of this report.

Urban ecology: Current issues and research avenues

Jonathan Sadler, University of Birmingham, UK

Urban areas are characterised by a diverse mosaic of relict habitats and designed spaces juxtaposed in combinations that rarely occur in nature. As such they are home to a wide diversity of organisms, many of which are becoming increasingly rare in the wider countryside (Gibson, 1998), where important ecological processes have been stymied by excessive monoculture agriculture. The current and predicted increase in urban population will lead to an intensification of land use that threatens to compromise these urban habitat refugia. Understanding how to accommodate sustainably both people and nature in cities overarching challenge for urban ecologists and requires a focus on a range of key scientific challenges:

Key Challenge 1: Deciphering the mosaic - Despite the complexity of the urban mosaic, a wealth of evidence exists illustrating gradients from the rural fringe to the city centre in a range of ecological variables (e.g. species richness) (e.g. Blair & Launer, 1997; McDonnell & Pickett, 1990), which suggest generic ecological responses to urbanisation. Certainly, many city centres have homogenised communities (McKinney, 2006), but Globenet has shown that gradients differ significantly between cities (Niemelä et al., 2002) as a result of their unique histories, spatial organisation, degrees of disturbance and so on. Although these studies have highlighted significant outcomes of urbanisation there is a great deal of covariation along the gradient that obscures the links between ecological pattern and process. It is now time to look past the generic gradient and focus on the details of the mosaic, namely the habitat patch and habitat matrix (see Snepp keynote).

Key Challenge 2: Understanding the role of connectivity and linkage. Many ecological theories (e.g. metapopulations, island biogeography, patch matrix models) predict that species occurrence is a function of habitat location, quality, and the characteristics of the surrounding matrix. Outside cities these theories have been heavily studied but the efficacy of: linkages via corridors (Angold et al., 2006), permeability of matrix, and habitat isolation are not well documented within cities. Similarly, gardens which are both habitats in their own right and potential linking habitats have been intensively studied in the UK (e.g. Smith et al., 2005; Smith et al., 2006) but less so elsewhere. There are also important linkages within the rural fringe (the so-called peri-urban zone) that require fuller evaluation (Snep et al., 2006).

Key Challenge 3: Understanding ecological process, function and performance - Disturbance is a central structuring force in urban areas and its effects vary widely both in type and scale, and are species and habitat specific making generalisations very difficult. The effects of disturbance are also manifest at a habitat scale where changes to hydrology, energy and nutrient cycles can alter ecosystem processes and function (Kaye et al., 2006; Shochat et al., 2006). Different habitats respond differently to disturbances, for example, more stable (usually relict) habitats with longer cycles to maturity (e.g. woodland) are more sensitive to urbanisation than other habitats such as wetlands and brownfields (Sadler et al., 2006; Small et al., 2006). There is also a pressing need to establish how the density of the built form affects habitat / ecosystem performance in terms of its effect on key processes (e.g. run-off retention, nutrient cycling and so on).

Key Challenge 4: Building for biodiversity - There clearly is a need to preserve habitats but there is also potential for 'green engineering' the built environment in a manner that maximises its ecological function. A myriad of green

technologies now exist that can be used for restoration and habitat creation; ranging from basic nest and roost boxes to broader scale initiatives such as permeable pavements, living walls and green (biodiversity) roofs, although few of these have been tested systematically (but cf. Gaston et al., 2005). Similarly, in parks and other public spaces (e.g. woodlands, river and canal corridors) there is potential for modifying management strategies to enhance habitats.

Key Challenge 5: Peopling the science - Last is not least here. Many authors have stressed the need to include the social dimension in urban ecology (e.g. Pickett et al., 2001). Cities are built for people who are the principle drivers of urban change; educating residents about the mutual benefits of urban biodiversity management and incorporating their views and opinions in such initiatives is essential for success. Understanding how science is used, the role of 'key actors' in decision making and how planning systems operate (Niemelä, 1999) is key to this and progress will require large (and truly) interdisciplinary teams examining similar aspects from different perspectives.

Progress in the above will be advanced by implementation of two research actions: (1) Toolkit development - There is a clear need for the development of robust indicators, new ways of capturing and representing data (e.g. in GIS models), and the development of modelling tools (e.g. decision support systems, spatially-explicit species models). (2) A better appreciation of the importance of scale and complexity - Issues of scale and complexity are central to understanding of how cities function as ecological entities. Cities are complex environments with layered interactions between species and the physical properties of landscape. Understanding how urbanisation affects these interactions is critically important as is determining which processes are scale invariant or scale dependent

RE: Urban ecology: Current issues and research avenues

Ulla Mortberg, Royal Institute of Technology, Stockholm, Sweden

The EMA research group (The Environmental Management and Assessment research group, Dept of Land and Water Resources Engineering, Royal Institute of Technology, Stockholm, Sweden) work with several projects concerning landscape ecological analysis and assessment in planning and environmental assessment, in particular concerning urbanisation. In this work, using GIS-based habitat modelling as a key tool, we frequently are faced with huge knowledge gaps concerning urbanisation and its effects on biodiversity.

In order to gain knowledge on this issue, comparative urban ecology need to be developed. So I agree on Jonathan's key challenges, and I find that point 2.1 in Jari's introduction is critical, to develop methods and indicators across Europe for comparative analyses and assessments. As I see it, this would include both 2.3, effects of habitat fragmentation, and 2.2, incorporation of the human dimension. So, the answer to the question at the end of point 2, I find it highly interesting with a EU-wide research project using a comparative approach to urban ecology!

There are many interesting trends in the studies already mentioned here, by Jonathan, Robbert, Susanna and others. Even if the general impression seem to be a decline of urban biodiversity, there are certain habitats and species that benefit, also concerning red-list species. These contradicting trends, the processes behind them and their implications for planning and management should be carefully analyzed. This

was well formulated by Jonathan, and I can only agree. Further, I would like to add to his Key challenge 4, on building for biodiversity, that "green engineering" could start already in policy and spatial planning, moving to landscape structures and then into detailed green construction and management.

Understanding complexities

Jari Niemelä, Chairman of the national organizing committee, University of Helsinki, Finland

Thanks Jon for your contribution. Yours together with Juliette's excellent summary of the first week provides a good basis for a research agenda for European urban ecologists. Your last research action (2) deals with complexity and scale. Could you elaborate a little bit? In particular, what do you mean by complexity? Ecological complexity or the social-ecological complexity of a city?

RE: Understanding complexities

Jonathan Sadler, University of Birmingham, UK

I see complexity here as meaning both aspects. We still have to understand the complexity of ecological interactions and how they vary in relation to urbanisation. Take the effect of fragmentation. It appears to affect differentially species in certain habitats. Does removal of certain species in this manner more profound knock-on effects - are there top-down and bottom-up trophic changes that we are not aware of? Are more complex ecosystems in terms of say food-web links more resistant to urbanisation?

The other issue related to this that is ticking away at the back of my mind is that site histories are important not only because they relate to disturbance histories. Take for example our globenet data. There was an overwhelming effect of site size and site location for the few truly woodland species - suggesting that fragmentation was a key process. But the 2nd smallest site in our survey had all the rural woodland specialists and it is located 2 miles from the city centre. They exist here because the habitat is relict from 200-300 years ago, when presumably more of the city was wooded. The site survived due to the odd land-use history of the area - in was encapsulated by first the Cadbury family who were big land owners then leased to the University in about 1900. I see this as a sort of 'ecological memory'.

As to the social-ecological complexity - this is a big unknown. Certainly our experience of this in Birmingham is that decisions regarding the fate of species / habitats during redevelopment are complex and extremely context driven. This means that generalisations as to likely outcomes are very difficult. Our focus in Birmingham has been on one tiny element of this - decision-making and especially when decisions are made relating to ecology and who makes and what knowledges they have at their disposal at the time the decisions are made. Interestingly, decisions taken at certain times become very important as they lead to a 'path dependency' of decisions taken later. That is, once this 'key' decision is made and an outcome is set in motion there is a lot of inertia in the decision-making process and it is very unlikely that the outcome will be changed.

Peopling the science

Robert Home, Swiss Federal Research Institute: Forest, Snow, and Landscape (WSL)

I would like to add a comment to point 5 of this topic, peopling the science. Many authors do indeed recognise the need for an understanding of social attitudes towards biodiversity, and many acknowledge the need for interdisciplinary research. However it is less often noted that the social sciences take a subordinate role in biodiversity research.

The role of the social scientist is to determine how to increase acceptance of measures to enhance or preserve biodiversity. This of course involves the measurement of such things as the wishes of the people, their understanding of biodiversity, and reactance to change. It is assumed however that the goal is to change the people so that they accept the conservation measure(s), hence the subordinacy. This raises some ethical questions.

Suppose, for a moment, that it was found that a community actively did not want a diverse ecosystem in their urban environment. Who then has the right to say that they are wrong and to set about changing their minds? Suppose that this community were to collectively say 'go and reach your 2010 and beyond target somewhere else'. Who has the right to reply that species richness is important and this community has to have it? It could be alternatively argued that the role of planners is to further the wishes of the people, in which case strategies should be sought to eliminate biodiversity in this fictitious community.

I am not claiming that this will happen, and I have no problem with social scientists adopting what could be equated to a market research position. If anything it underlines the need for coordination in the necessary interdisciplinary research. I merely venture the opinion that this is the ground upon which we tread.

Standardization and indicators

Fabio Attorre, University of Rome "La Sapienza", Italy

As a plant ecologist I am working on two projects relevant to points 2 (Functioning of urban ecosystems) and 3 (Effects of habitat fragmentation and the role of urban ecological corridors) of the list proposed by Jari Niemela.

A huge number of studies have been conducted on these topics and many GIS-based tools have been developed since now. Through considering the environmental and historical differences between the cities, a comparative analysis using the same approach became fundamental: indicators, sampling methods, statistical analysis. The results of this effort could be used to support other points of the list where the involvement of political, socio-economic and psychological factors is required.

Many cities have already a great amount of available digital data that can be used to this purpose, so that the project could be quickly focused on something specific, i.e. the elaboration of a Decision Support System for Urban Areas based on systemic approach.

Urban ecology in Russian cities

Vladimir Vershinin, Laboratory of ecological monitoring

Because of the imperfection of Russian nature conservation laws and rules we have serious differences in the spectrum of problems connected with biodiversity decreasing and urban environment protection. For example our ecological expertise before building is almost formal – nobody seriously cares about the destiny of animal populations within city borders.

But we have knowledge of urban population studies on amphibians (29 years), small rodents (about 15 years), insectivorous (about 7 years), reptiles (6 years) and soil invertebrates, mostly Elateridae beetles, about 15 years. So we have information on the reproductive strategy of urban animals. Also we have data on ecophysiology of urban amphibians, their genetic specificity, trophic relations, mortality, age structure, ontogenesis, morphology and teratology.

We know the main directions of adaptation on physiological, populations and community level to urban environment. We have information on tolerance of different species and reasons of disappearance of another. Thus it's possible to say that urban communities are a good for natural experimental plots for population and microevolution study.

How can landscape ecological research contribute to the understanding of the urban ecosystem?

Robbert Snep, Alterra - Wageningen University Research, The Netherlands

In 1967 MacArthur and Wilson proposed their Theory of Island Biogeography, describing the number of species inhabiting an island as a dynamic equilibrium between opposing rates of extinction and colonization, which are functions of the size of an island and its distance from a source of dispersing species, respectively. With this model the strong relation between plant and animal species and the landscape they occur in was demonstrated for the first time. In the 1970's and 80's more research was conducted on the interrelationship between spatial patterns of landscape elements and the ecological processes in plant and animal populations. This led not only to new insights about species' survival, but also to the establishment of a whole new field of ecological science: landscape ecology. These days the Metapopulation Theory (Opdam, 1991) can be considered as one of the more dominant concepts in landscape ecology, originated from that period. The metapopulation theory explains how plant and animal species can survive in highly fragmented landscapes. The continuous interaction between local populations, caused by dispersal of individuals, is considered one of the key factors in the long-term survival of the metapopulation as a whole. Barriers and other phenomena caused by habitat fragmentation limit such exchange of individuals between populations.

Landscape ecology as a science exists about 30 years now, a period during which thousands of studies were conducted. Most landscape ecological studies focus on rural areas, considering urban areas as a threat to species' survival rather than a new type of landscape that asks for research. In urban ecological studies it seems to be the opposite case. Although many urban ecologists looked to species' distribution in cities, few studies seriously examine the importance of spatial relations in urban plant and animal populations. Dispersal rates, genetic exchange, source-sink relations and other commonly studied aspects in landscape ecology are rather unknown in urban ecological science. This could perhaps be explained by the fact that the science of urban ecology is relatively young and that it is only now that we start to recognize the contribution of urban habitats to overall biodiversity conservation, and the importance of urban nature as support for citizens' ideas about nature conservation.

To conclude, I would like to discuss the application value of landscape ecological principles in urban environments. As stated, little is yet known about this. We could however – based on our current knowledge about the urban ecosystem - argue whether spatial relations could probably play such a key role in the survival of urban species as they do in rural species. If habitat loss, isolation and disturbance are main negative factors in rural areas, what about cities? Ground-dwelling animals can be found up to city centres (in low densities, perhaps because little habitat is available?). Green roofs present at high altitudes (e.g. at the Chicago City Hall) are colonized by bees, butterflies and birds…so what about habitat isolation? Are cities sinks that only consume plants and animals rather than providing them a suitable habitat? Is the species richness of city-edges a result of continuous colonization by rural individuals and ongoing introduction of plants and animals by humans?

All these questions ask for more international cooperation between urban ecological researchers. I'm convinced that it is only then that we will be able to understand how the urban ecosystem is working, and how we can apply our insights in landscape ecology into the conservation of (urban) nature.

Summary of research priorities identified in Week 1

Juliette Young, CEH Banchory, UK

Research priorities identified in Week 1 of this session include:

1. Relevance of urban green space for the urban dwellers.

- Improve understanding of the attitudes of urban residents towards urban green spaces, and in particular to biodiversity

2. Functioning of urban ecosystems.

- Increase research into the details of the mosaic, namely the habitat patch and habitat matrix.
- Better understating of the role of connectivity and linkage.
- Understanding how urbanisation affects interactions between species and the physical properties of landscape is critically important as is determining which processes are scale invariant or scale dependent

3. Effects of human activities, such as habitat fragmentation, on urban ecology and biodiversity.

- Establish the role of disturbance in urban ecology.
- Establish how the density of the built form affects habitat / ecosystem performance in terms of its effect on key processes (e.g. run-off retention, nutrient cycling and so on).

4. Development of standardized methods and indicators across Europe for comparative assessment and monitoring of the state and trends of urban biodiversity.

- Develop robust indicators, new ways of capturing and representing data (e.g. in GIS models), and modelling tools (e.g. decision support systems, spatially-explicit species models).

5. Integrating urban ecological research into urban planning for the maintenance of biodiversity in urban areas.

- Explore the potential for 'green engineering' the built environment in a manner that maximises its ecological function.
- Promote interdisciplinarity in order to better integrate sustainability into urban planning.
- Understanding how science is used, the role of 'key actors' in decision making and how planning systems operate is key to this and progress will require large (and truly) interdisciplinary teams examining similar aspects from different perspectives.

Urban biodiversity management – lessons from the Millennium Ecosystem Assessment in Stockholm

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Thomas Elmqvist, Department of Systems Ecology, Stockholm University.

Taking the example of Stockholm County, the author describes how adaptive capacity can be built to better cope with change and the conditions needed for more effective ways to manage urban ecosystem services.

Stockholm County has the largest population concentration in Sweden with more than 1.8 million people and is projected to grow to 2.4 million people within 30 years. Due to population increase and urban development, the region displays a quite dramatic loss of biodiversity. Within the Millennium Ecosystem Assessment (MA) we investigated how adaptive capacity can be built to better cope with change and conditions for more effective ways to manage urban ecosystem services. The assessment covered the greater metropolitan area of Stockholm including the Stockholm National Urban Park (NUP) a 2700 ha woodland area located adjacent to the inner city of Stockholm. The biodiversity that characterize the NUP today is a result of a long history of human interaction with the physical environment. In fact, there is no other area in Sweden of the same size, where similar high species richness has been described. Despite legal protection of the park since 1995, there has been a continuous pressure on the park's fringe areas due to urban growth.

One of the most important challenges is to manage urban ecosystems in a way that does not erode their capacity to cope with environmental change. Our assessment has focused on the provision of ecosystem services and functions and the support provided by green areas. In this context, the role of local users, their management practices, institutional arrangements, and local ecological knowledge related to the use and management of green areas and ecosystem services was investigated. The green areas in Stockholm County deliver numerous ecosystem services, i.e.: air filtration; regulation of microclimate; noise reduction; surface water drainage; recreational and cultural values and nutrient retention. Recreation represents an important ecosystem service, it is estimated that NUP has 15 million visitors per year and that 97% of the urban population in Stockholm will visit one of the urban green areas once a year, 47% will make visits every week.

Efforts to reduce the loss of green areas and biodiversity have traditionally been based on governmental policies, including the establishment of nature reserves and national parks. However in our analysis it became clear that a large local public response exists through interest groups and local stakeholders who are influencing biodiversity management through their own land use and management practices. Linked to NUP alone there are some 69 non-governmental organizations representing 175,000 members that are loosely involved in green area management. Out of these, some 40 organisations, ranging from users of the park to culture and nature conservation groups, are politically active in protecting the NUP from exploitation. Through a social network analysis we found that these are structured in a core and periphery in which the core has developed effective methods to protect the park from macro-exploitation and is leaning on the periphery for legitimacy and awareness of micro-exploitations. A major aim of our analysis has been to evaluate the prospects of introducing arenas of adaptive co-management to supplement the current management paradigm. Our results indicate that areas of informal management represent centers on which to base adaptive co-management or polycentric networks, with the potential to strengthen biodiversity management. We found that informal management of local

green areas has important functions: i) the groups are often organized in a way that increases the potential for experimentation and learning, ii) they often hold attributes which may complement conventional biodiversity management, such as local ecological knowledge, sense of place, and norms and rules that serve to protect functional groups of species.

We also analysed how management is related to different temporal and spatial scales within the Stockholm Metropolitan Area. We found that 1) several spatial, temporal and functional scales are recognized but cross-scale interactions are neglected and 2) spatial and temporal meso-scales are not defined or managed. One potential implication of a neglect of ecological cross-scale interactions in these highly fragmented landscapes is a gradual depletion of the capacity of the ecosystems to provide ecosystem services. Two important strategies for overcoming urban scale mismatches are 1) development of an integrative view of the whole urban social-ecological landscape, and 2) support practical management by creating adaptive governance systems.

Looking at a more global scale, similar issues have been raised in discussions of creating urban biosphere reserves within the UNESCO Man and the Biosphere program. Urban Biospheres could provide alternative modes of governance for regional sustainability and management of ecosystem services, creating a public space to invest in a dynamic relationship between people, their natural environment and the various forms of governance of the urban landscape. Exploration of the urban biosphere concept is taking place in cities like Cape Town, South Africa, New Orleans, USA and Canberra, Australia.

Summary of research priorities identified in Week 2

Juliette Young, CEH Banchory, UK

Research priorities identified in Week 2 of this session include:
1. Relevance of urban green space for the urban dwellers.
2. Functioning of urban ecosystems.
- Increased research on understanding the complexity of ecological interactions and how they vary in relation to urbanisation.
3. Effects of human activities, such as habitat fragmentation, on urban ecology and biodiversity.
- Research on understanding social-ecological complexity
4. Development of standardized methods and indicators across Europe for comparative assessment and monitoring of the state and trends of urban biodiversity.
5. Integrating urban ecological research into urban planning for the maintenance of biodiversity in urban areas.
- Exploring the role of adaptive capacity in light of environmental change
- Better understand the conditions needed for more effective ways to manage urban ecosystem services.
- Promote the development of an integrative view of the whole urban socio-ecological landscape.
- Develop adaptive governance systems to support practical management.

Addendum to research list

Irina Herzon, University of Helsinki, Finland

I think one key point is missing from the summary list presented by Juliette Young – that is, "Improve understanding and appreciation of urban green spaces, and in particular biodiversity, by urban residents". I will probably say a heresy now but, to my mind, this is actually THE key issue in urban environments. Preserving and sustaining biodiversity within remaining (semi) natural environments is surely of a much higher priority for the overall conservation than attempts to preserve biodiversity within highly fragmented and intensively managed areas in urban spaces. They are, most probably and in most cases, not self-sustaining without a wider non-urban environment anyway. Why we need biodiversity within our cities is not for biodiversity itself (there are no endemic urban species as yet, and for many species these are sink populations, at least for larger species such as birds). Above all, I believe, people need biodiversity around them, in the cities, for their own sake. How can we teach our children about diversity of life of the planet if grow them we among monotonous green lawns and manicured park trees? All the areas of natural diversity in cities, such as surviving streams and so-called wastelands, are exceptionally important learning environments.

I acknowledge that this is not, strictly speaking, a research question rather a highly relevant application. I was pleased to notice how ideas of two conference lines – on Urban ecology and on Youth and education – come together, see communications from Jari Lyytimäki and Mauri Åhlberg.

RE: Addendum to research list

Robbert Snep, Alterra - Wageningen University Research, The Netherlands

I would like to emphasize that Irina Herzon in her mail is indeed addressing a very important point, to be added to the summary of this E-Conference. If we expect people to care for nature, it is important that those people have at least a global idea of what biodiversity is all about. Scientific reports as well as TV-documentaries about endangered species are insufficient in prioritising the urge for nature conservation in people's mind. Experiencing biodiversity real-life, by observing plants and animals in their habitat, has a much higher impact on the understanding why it is necessary to conserve nature.

As referred to in many urban ecological publications, the UN has in recent reports frequently indicated that since the beginning of this millennium more than 50% of the human populations is living in cities. This means that the majority of people have to be able to experience nature in their neighbourhood... this neighbourhood being an urban environment. Urban nature has therefore a key role in promoting the understanding of biodiversity and the urge to protect ecosystems.

Irina Herzon is not quite sure whether her question can be considered as scientific. I've broadened her point from 'appreciation of local green' up to 'contribution of urban biodiversity to people's understanding of the urge for global nature conservation'. Whether this is scientific or not, it should be a point that we - as urban ecological researchers - should always include in our research. As long as most children these days have even no basic understanding of biodiversity (research from my Alterra-colleague Jana Verboom) and many of those children grow up in cities (see UN-reports), there is a lot that we as researchers have to do - in cooperation with schools, policy-makers and others - to make sure that people will still care for biodiversity in the future!

RE: Addendum to research list

Robert Home, Swiss Federal Research Institute: Forest, Snow, and Landscape (WSL)

I would like to comment on Irina Herzon's observation about the overlap between the 'urban ecology' and 'youth and biodiversity' conference topics. It seems that we have converged on the issue of engaging the people who will be the key to the success of implementation strategies.

Per-Olof Wickman points out that biodiversity problems become more interesting to people if they can gain something else from protecting biodiversity. Zurich is a reasonably green city, yet the results of the Biodivercity project suggest that residents see the city as 'people space' with nature tolerated provided it is some benefit, or at least not detrimental, to people. It would not be a great surprise to find that attitudes in Zurich are not atypical. Irina believes that 'people need biodiversity around them, in the cities, for their own sake'. I share her belief wholeheartedly, yet if the people themselves do not see biodiversity as beneficial, it will not be accepted, regardless of the strength of ecological arguments.

Again I find this underlines a recurring theme of this conference in the need for research to be interdisciplinary. However, Frank Waetzold is correct in his posting (October 6) that it is not sufficient to let every discipline do its own work and then put the results together. Certainly the ecological arguments must be made, but I believe that Per-Olof's statement of the importance of seeing the interests that the young generation has and finding solutions to conflicts applies equally to the community at large. I believe that such solutions are best found when ecological and social research is designed to collaborate and look for them.

Jonathan Sadler pointed out that 'scientists and engineers had to embrace a whole new language and adopt methods (and writing styles) that were both unfamiliar and uncomfortable.' That has also been our experience in the Biodivercity project. It became apparent very early that ecologists and social scientists use different languages and see the world in different ways. Among our challenges has been to learn what the other is talking about. A further challenge will be to present our results in a language comprehensible to the various groups to whom we will be presenting them.

An example of a potential coincidence of interest that has been found in the Biodivercity project is that parents of young children actively seek out species rich landscapes (my ecologist colleagues describe them as 'habitats') because of the stimulation that their children receive. The qualifier 'potential' is included because there are many other characteristics which parents consider when assessing urban landscapes. Among our aims is to find the conditions where the needs of nature and the needs of parents most closely meet. I understand this as being another example of the connections that Per-Olof is referring to.

RE: Addendum to research list

Susanna Lehvävirta, University of Helsinki, Finland

I have a brief comment on the discussion of the importance of urban green areas for learning vs. biodiversity per se (related to Irina Herzon's comments and discussion following them).

It is true that these areas are highly valuable for environmental learning, both structured (planned, formal education) and unstructured (everyday personal experiences). However, I want to point out that there are habitats for threatened species in the urban environments. For example in Finland, the greater Helsinki area (capital of Finland plus its surrounding cities), threatened vascular plants have been found on ruderals and road verges, threatened wood decaying fungi in urban woods and park trees, as well as invertebrates. I have also suggested that provision of dead wood could offer habitats for species that are threatened because of lack of dead wood in commercial forests.

My point is that even if urban green areas are not good for preservation of all kinds of species, there could be a significant number of species that could survive and do well in urban areas if suitable microhabitats are maintained or created. Hypothetically, these species have common characteristics. For example, it can be hypothesised that they are good dispersers, and are not susceptible to, or can escape urban pressures (such as pollution or trampling). I do not attempt to finish this line of thinking, I just want to highlight the potential of urban habitats for biodiversity per se.

Urban aquatic biodiversity

Stephen Hawkins, Marine Biological Association, UK

One key area of urban biodiversity that is available for both education and research as well as worthy of conservation efforts is aquatic biodiversity, whether rivers, streams, ponds, estuaries or areas of coastline including sea defences.

Simple restoration measures can turn unpromising areas such as disused docks into healthy ecosystems available to educate all- moreover phyletic diversity is very high with cnidaria, echinoderms, ascidia and many other groups with few terrestrial representatives (see recent Cambridge volumes on restoration ecology for reviews e.g., Hawkins et al in Perrow and Davey, 2002).

Urban coasts can provide analogues of natural systems and provide easy access by rock pooling or (at least in the Mediterranean) by snorkelling.

Floristic biodiversity – a central European perspective

Ingolf Kühn, UFZ – Centre for Environmental Research, Leipzig, Germany

The author describes floristic biodiversity in urban areas and argues for further research on patterns of distribution and species composition within cities and among cities using a common framework with finer resolution but larger extent.

It is well documented from several areas in Central Europe and the United States of America and across several spatial scales (from a few hundred square meters to several hundred square kilometres) that urban areas harbour more plant species than surrounding (non-urban) areas. There are several hypotheses to explain this pattern. The most popular ones are that this pattern is caused by (i) alien plant species, (ii) a sampling artefact, (iii) anthropogenic land-use heterogeneity and (iv) because people settled in biodiversity hotspots. For Germany, we were able to show that cities are also more species rich in native plants than rural areas and this pattern can largely be explained by the richness of different geological substrates (a natural phenomenon) (Kühn et al., 2004). This species richness is augmented by alien plant species, which are favoured by land use heterogeneity. We do not need to employ a sampling artefact to explain this pattern. Furthermore, cities are not randomly distributed but in areas of extraordinary high geological richness (e.g., having rivers as waterways, elevations suitable for an outlook/castle, arable land, minerals etc.). Therefore we argued that they are already placed in naturally species rich areas.

In another analysis we studied the effect of urbanisation on species composition and found that for native as well as archaeophytic (species arrived prior to 1500) species, species composition among cities is more similar than among rural areas while for neophytes (post 1500 plant species) we were able to show differentiation effects (Kühn et al., 2006). Therefore urbanisation leads to the loss of rare native (and maybe the increase of common native) species as well as the increase of different neophytic alien species.

It is thus clear that urbanisation does not promote species richness but was simply not efficient enough to reduce urban species richness to an average landscape lever or lower. Nevertheless, urbanisation decreases native plant species diversity and promotes native species homogenisation.

However, there is no clear trend from rural areas into a city centre. Actually, it is often observed that species richness increases in peri-urban areas and is drastically reduced in the very centre. A city, hence, does not have a clear gradient but consists of many patches, which differ largely in their degree of urbanisation. Therefore, even in the centre one can find patches which are almost semi-natural and species rich in native plants and in the periphery are patches completely build up or covered by asphalt.

Therefore, we need further detailed studies on precise, spatially explicit patterns of distribution and species composition within cities and among cities using a common framework with finer resolution but larger extent (e.g. Europe). Only then it will be possible to derive customized programmes to conserve specifically urban floristic biodiversity.

RE: Floristic biodiversity – a central European perspective

Susanna Lehvävirta, University of Helsinki, Finland

I have a philosophical-methodological comment that relates to Ingolf Kuehn's request for "further research on patterns of distribution and species composition within cities and among cities using a common framework with finer resolution but larger extent".

Obviously, there is a need for comparative research, and for that purpose common designs are most efficient, just as Ingolf suggests. I also agree that finer resolution of patterns is a necessary development as they bring us closer to the actual mechanisms. As scientists, often our final goal is to reveal causal mechanisms producing the observed patterns, and sometimes, manipulative experiments may be needed. However, often revealing small-scale patterns related to a certain type of human activity is already useful for giving planning and management guidelines.

What does this mean in practice? I give an example. A group of scientists is interested in the effects of urbanisation on biota. First, the aspects of urbanisation to be studied have to be chosen, as urbanisation is a complex system of factors, and it is not particularly informative if we find out that "urbanisation-what-ever-it-includes" affects the biota.

First, imagine that the scientists choose to sample along a gradient of urbanization. What would the scientific conclusions be? To be honest, they will only be able to discuss possible mechanisms behind observed changes in biota. This discussion could have been possible also without any measurements, based on previous knowledge. What would be the instructions to city planners of mangers of green areas? Avoid urbanisation?

Second, imagine that instead of a large-scale gradient, the scientists decide to be explicit about a mechanism that they test. Thus, based on previous knowledge, they choose first one or two mechanisms to study, and plan the data collection so that the focal factor(s) varies (vary). The rest of all recognizable aspects of urbanisation they try to keep constant in the study, by choosing the sampling points appropriately.

Now, provided the scientists were successful in their data generation procedure, they can explicitly test for the selected factors. They could then obviously make solid scientific conclusions about the magnitude of the effect (i.e. ecological importance) of this factor. Furthermore, they would be able to give guidelines for city planners and alike to control for unwanted effects brought about the studied factor, if such exist.

The project ET I mentioned earlier in this conference is just one example of potential designs to reveal mechanisms. Others can be planned along different kinds of pollution or isolation gradients, for example.

Importantly, these kinds of studies do not need to focus on a single taxon or ecosystem. This kind of research is mechanism-oriented (instead of being taxon-oriented), and thus any (set of) species, or ecosystems that is relevant from the point of view of the focal mechanism can be used as a "research tool".

I suggest it is time for us to move towards explicit testing of single mechanisms, to be able to develop urban ecological theory, and to be able to give planning and management guidelines.

Biodiversity of Prague: past, present and future perspectives

Tomas Kucera, Institute of Systems Biology and Ecology, Academy of Sciences of the Czech Republic

In the last century the biodiversity of Prague has increased significantly several times. This increasing trend should be illustrated on the regional example of the flora of Prague, the capital of the Czech Republic. The main influences on species diversity were: (i) enlarging the area of Prague (and therefore the species number according to species-area equation), (ii) habitat loss of some threatened and vulnerable habitats and species becoming extinct, (iii) spreading of alien (non-native) species from horticulture, by viatic migration, or spontaneously. These main factors are supported by present-day continental transport, environmental pollution, and global warming.

These changes have been surveyed occasionally in historical floristic investigations. The comparison of historical and present-day species lists can help us to understand the background and the reasons behind the changes. Although it meets with many methodological problems (such as different scaling and sampling, methodology, determination, etc.), the species comparison illustrates the habitat loss of all traditionally hand-made managed plots, i.e. chicken-run, sheep-ground, crofts, wet oligotrophic meadows, sedge and fen meadows and shallow waters and swamps. Intensive landscape management, especially grazing, mowing and small-scale management had a positive influence on biodiversity. The absence of this regular management has led to the extinction of many rare species (i.e. orchids, sedges, rushes, etc.). On the other hand the new man-made habitats host the new alien species. Although the native vulnerable and threatened species vanish, the total species number increases due to the species invasion. Therefore I suggest measuring and inventoring the native species separately from the non-native species.

Biodiversity oriented landscape management is of fundamental importance in landscape/urban planning. The identification of current and potential native, natural and seminatural habitats should be considered the first step in urban planning. The connection with the green structures should be the second step, and the corridors to the surrounding greenland the third one. Natural habitat rehabilitation and restoration could be realised in abandoned land, such as wetlands in plains, quarries, orchards, dry grasslands, etc. The native biodiversity should be considered the non profitable value and/or the life quality indicator (see Table 2).

Table 2. Biodiversity of plant species: the trends over the 130 years. The comparison of plant species is based on the list of Čelakovský (1870) and Špryňar et Münzbergová (1998)

Indicator	Status	Present
Area of Prague	Severalfold increased	496 km^2
Number of protected areas	Increasing	88 NR + 1 LPA
Number of threatened species	Extinct	53 sp.
Number of native species	Little increased	1587 sp.
Number of alien species	Manifold increased	580 sp.
Total number of species	Double increased	2185 sp.

NR – nature reserve, LPA – landscape protected area

Summary Final Week

Juliette Young, CEH Banchory, UK

Research priorities identified in the final week of the e-conference include:
 1. Relevance of urban green space for the urban dwellers.
- Improve understanding and appreciation of urban green spaces, and in particular biodiversity, by urban residents
- Develop methods to encourage urban green space (including urban aquatic zones) as learning areas; and for biodiversity per se.
- Improve knowledge of the contribution of urban biodiversity to people's understanding of the urge for global nature conservation
- Promote urban aquatic biodiversity, whether rivers, streams, ponds, estuaries or areas of coastline including sea defences.
 2. Functioning of urban ecosystems.
- Research on the identification of current and potential native, natural and semi-natural habitats as well as their connection with the green structures and corridors to the surrounding nature.
 3. Effects of human activities, such as habitat fragmentation, on urban ecology and biodiversity.
 4. Development of standardized methods and indicators across Europe for comparative assessment and monitoring of the state and trends of urban biodiversity.
- Detailed studies on precise, spatially explicit patterns of distribution and species composition within cities and among cities using a common framework with finer resolution but larger extent (e.g. Europe)
 5. Integrating urban ecological research into urban planning for the maintenance of biodiversity in urban areas.
- Promote mechanism-oriented (instead of being taxon-oriented) research to further develop urban ecological theory and provide effective planning and management guidelines.
- Promote ways in which to encourage interdisciplinary research in urban ecology
- Develop methods to present scientific findings in a comprehensible and accessible way
 Many thanks to all contributors to this session for your insightful contributions. All the research priorities identified in this session will be compiled and will form the basis for the EPBRS meeting in Helsinki in November.

Youth and Biodiversity

Introduction to the Youth and Biodiversity session

Mauri Åhlberg, E-Conference Chair, University of Helsinki, Finland.

The main issues to be discussed during the e-conference are:
(1) Innovations to promote biodiversity education through the co-operation of teachers and scientists.
(2) Schools as activators of the monitoring of environmental change and biodiversity.
(3) What is the current position of biodiversity education in general education, in vocational education, and in adult education?
(4) Citizens as collectors, co-builders and users of biodiversity knowledge.
(5) Co-operation with scientists, teachers, civil servants, policy-makers and schools in promoting biodiversity (problems and solutions of communication).
(6) What are the gaps in our knowledge and understanding of biodiversity education and learning?
(7) What is strategically important research that should be undertaken for promoting biodiversity education and learning?

It is widely accepted that biodiversity loss is happening not only in the tropics, but also in Europe. Its nature and causes need far better public understanding and learning in order for it to be stopped. In the future, it may be that biodiversity can be also be maintained and even promoted if the public learns the best theories and practices of what to do and what not to do. Our EU economy creates wealth for protecting, monitoring and promoting biodiversity. Modern economy is dependent on innovations, and schools as part of EU societies ought to use and promote innovations, whenever it is also educationally valuable. The Internet, WWW and GIS are examples of such innovations, and have plenty to offer to Biodiversity Education to conserve, monitor and promote biodiversity. Internet and WWW have practically connected the whole of humankind. If we include also other media such as TV, radio and newspapers, it can be argued that the whole of humankind can learn to conserve and promote biodiversity.

In this e-conference we will discuss plenty of educational uses of Information and Communication Technology. However, there are also many reasons to teach and learn outdoors. Also, modern mobile technology can be used also in nature, out of school.

In this session on "Youth and Biodiversity" we will have several keynote contributions focussing on the seven main issues listed above, which we hope will lead to productive dialogue.

We hope that this e-conference will help us to formulate a good resume proposal for policy makers, on what ought to be done in biodiversity education as part of Education for Sustainable Development, in order to monitor, prevent biodiversity loss and hopefully to promote biodiversity.

Traditional and innovative approaches to biodiversity education

Horst Freiberg, Federal Agency for Nature Conservation, Germany

The topic of "Youth and biodiversity" is fairly broad and surely has many facets. Everybody who works on this knows how difficult this task is in real life. Therefore my contribution focuses on the use of the Internet and questions 1 and 2 (namely innovations to promote biodiversity through the cooperation of teachers and scientists and; schools as activators of the monitoring of environmental change and biodiversity) of Mauri Ahlberg's introduction.

Many educational networks or nature-oriented networks exist in Europe (as part of the formal or informal education sector for youth and adults) which relate their activities to "biodiversity" in one way or the other. These networks should become more aware about "Biodiversity" as a topic. Yet some networks are linked to biodiversity and nature. Examples include:
- Young Reporters for the Environment www.youngreporters.org/
- ENO www.joensuu.fi/eno
- The GLOBE Network www.globe.gov (clearly scientifically driven)
- The regional event-observations presented by Naturdetektive www.naturdetektive.de/2006/dyn/1876.php
- The European SchoolNet www.eun.org.

Undoubtedly biodiversity "needs a face" for young and adult people. Even if this proposal appears "old-fashioned" – but reactions may surprise. Simple competitions on European Biodiversity among schools (including the public) could promote our topic and could perform one of the possible elements. One should reflect and invest some time on this kind of "incentive".

But these are traditional, old-fashioned (?) approaches. A more future-oriented innovative approach to give young and adult people an understanding of biodiversity (for instance: monitoring of biodiversity) should make use of the WAP Browser technology as part of Mobiles. Technology has improved so rapidly that mobiles today facilitate the integration of small WAP Browsers – providing for example simple maps where observations can be charted via Mobile computing. In 5-10 years this will be much more efficient and applicable anywhere. This could become an interesting area for future "public biodiversity monitoring".

RE: Traditional and innovative approaches to biodiversity education

Mauri Åhlberg, E-Conference Chair, University of Helsinki, Finland.

This contribution is excellent. Both practice and educational research on biodiversity education are neglected. The list of networks looks long, but only a very small part of their activities is directed into biodiversity education.

I agree that students love competitions, and these can be arranged for in biodiversity education. I am involved in the NatureGate(R) R&D program in which we plan to concentrate on collaborative knowledge building. However from time to time, we plan to have competitions, for example competitions for the best plant photograph etc.

The idea of WAP Browser and small maps is very interesting one. Has it been tried anywhere? I think that this could form the basis for a big EU R&D project. Who else would be interested in it? I hope Horst at least. But can we find more researchers willing to join us and make a big EU bid for this kind of project? At least two research groups in Finland are planning to implement GIS and modern mobile phones with digital cameras in promoting biodiversity education: NatureGate and Jouko Rikkinen's Virtual Flora, both at University of Helsinki. This is a start.

RE: Traditional and innovative approaches to biodiversity education

Wouter Los, University of Amsterdam, The Netherlands

With respect to non-traditional approaches, the BioBlitz initiative can be considered http://www.pwrc.usgs.gov/blitz/. It aims at counting as many species from as many taxonomic groups in a 24-hour time period in a relatively small urban environment (can be a park, but also a street or school garden). It is a typical school + family occasion with an element of competition and also to compare outcomes with other sites. Recent 'Biodiversity Day' activities in different cities include the adoption of the BioBlitz approach.

With respect to WAP technology, I can mention the interesting development of Artportalen in Sweden http://artportalen.se/default.asp on mapping, and the work of ETI biodiversity centre http://www.eti.uva.nl/ on species identification with WAP technology in mobile phones.

See also "Migrating Birds Know No Boundaries", an educational project in Israel to promote a cross-border community of school children in the whole region appreciating biodiversity more than human fights www.birds.org.il/show_item.asp?levelId=805.

RE: Traditional and innovative approaches to biodiversity education

Mauri Åhlberg, E-Conference Chair, University of Helsinki, Finland.

I enjoyed the description of the BioBlitz initiative. I guess that in the most European countries a couple of hours searching for species on a biologically interesting site in the neighbourhood, would be a good start. We know as biologists and biology educators that parks, roadsides, waste lands can be biologically very rich and interesting. However, 24 hours search as a competition would probably raise the most public interest. Perhaps even teams of pupils and teachers could compete. It seems that it needs a committee of biology experts to check the findings. In my mind the best long-term approach would be that schools start to make cumulative inquiries and collaborative knowledge building on some for pupils important area near school. This would increase cumulatively shared knowledge of biodiversity of their surroundings. Also a long enough visit to localities from which part of their food comes and having a biodiversity survey there, might be a worthwhile exercise. There is nowadays a good environment for cumulative long term collaborative knowledge building and sharing: CmapTools, http://cmap.ihmc.us/. If somebody is interested in its possibilities, I am happy to provide more information.

RE: Traditional and innovative approaches to biodiversity education

Horst Freiberg, Federal Agency for Nature Conservation, Germany

I believe that this could really perform an innovative R&D approach. Let us enlarge it by adding a "species recognition" element to the Mobiles which could facilitate the participation by schools and the public in general in monitoring activities - complementing "traditional" forms of monitoring and providing support to scientific research. Let us use our imagination that in a not far time Mobiles will have better microphones (or one to plug) and better lenses this would make species recognition in our context of biodiversity monitoring much broader applicable than ever before. Either the Mobile would have integrated a "check list of voices/images" or the voices/images would be sent to a database providing then a feed-back. I again repeat that in 5-10 years this can be reality and we the biodiversity research community should be part of it.

RE: Traditional and innovative approaches to biodiversity education

Norbert Hirneisen, Verlag fuer interaktive Medien, Germany

I agree with Horst Freiberg - mobiles will become a very useful and important tool on biodiversity observation and determination. We have been thinking about his since 2001 and right now we are developing a java-based software for mobiles to use our discussion boards at science4you.org. In a first stage postings with image upload and simple keyboarding of locality information will be implemented, so observations could be posted directly. In a second stage we will implement determination tools to support nature spotters in the field. This will be very important for the German Butterfly Monitoring project, directed by the UFZ in Leipzig. In this project we have a lot of newbies who will be thankful for mobile determination aides. Of course, the development of these techniques is a major task and we would like to cooperate and combine our efforts with other projects.

Handheld GPS

Patricia Mergen, Royal Museum for Central Africa , Belgium

I also agree that the WAP approach is interesting. Additionally and according to what is going on in the Geographic Information Systems (GIS) field, it would also be worthwhile to consider the usage of handheld GPS.

Concrete solutions already exist: In a posting of the OpenGIS (OGC) Mailing list: "If you have a mobile device or cell phone loaded with software called "Spot," you can download map images from any Web server that makes maps available through an implementation of the OpenGIS(r) Web Map Server (WMS) Specification. Spot includes an integrated Google maps layer which can be used in combination with WMS layers" www.skylab-mobilesystems.com/en/products/j2me_wms_client.html

An interesting initiative is also the GPS Guided Tour in the French Mercantour National Parc. The provided GPS is not just to find your way but gives

also information on the local fauna and flora and includes educational games to teach the visitors how to identify plants or animals along the way www.petitfute.com/actualites/actu-pays.php?ref=376&code_destinationD000)

RE: Handheld GPS

Mauri Åhlberg, E-Conference Chair, University of Helsinki, Finland.

I found out that, in 2003, Patricia chaired a European Network for Biodiversity Information e-conference .

It brings to my mind the fact that it is important to deliver and have an easy access to biodiversity information for all citizens of EU. The task of Biodiversity Education is to transform relevant parts of available information into personal and public knowledge and reasoned action. In my mind, the best way to do it is through a combination of inquiring learning and collaborative knowledge building. To promote biodiversity education, I am very interested in what kind of possibilities there are for easy access to biodiversity information in the WWW. Is there any hub for those kinds of links? Or is the only option just to use Google and hope for the best? NatureGate® R&D project, in which I am involved, has a vision of becoming one of the global portals or hubs for Biodiversity and Sustainable Development. Naturegate® is in progress, not currently available. What options are currently available for finding biodiversity information?

New conceptual and empirical approaches for curricular and extra-curricular biodiversity education

Susanne Bögeholz, Göttingen University

Summary: The core challenge of a – necessarily! – interdisciplinary biodiversity education consists of fostering competences for a systematic integration of facts and values regarding non-trivial real world decision-making.

Biodiversity education is a part of education for sustainable development (ESD). ESD differs from traditional environmental education by its emphasis on social and environmental justice and an interdisciplinary approach to problem definition and design of potential solutions. Currently, most educational interventions regarding biodiversity aim at enhancing ecological knowledge and fostering appreciation of biodiversity e.g. by means of nature experience, however (e.g. Lindemann-Matthies 2002, Bögeholz et al. 2006). One central interdisciplinary challenge is posed by the problem to systematically integrate facts and values for real world decision-making in the face of factual and ethical complexity (Bögeholz & Barkmann 2003). This need for integration is typical for many resource-use-dilemmas that underlie most environmental problems. From this perspective, environmental knowledge as well as offering opportunities for value building by nature experience need to be integrated into a wider framework of decision-making in real world situations (Bögeholz 2006, Bögeholz et al. 2006, cf. Gardner & Stern 1996). Work on elements of a respective research programme targeting the whole spectrum from kindergarden via curricula and extra-curricula education to teacher training has recently commenced (e.g. Bögeholz et al. 2005, Menzel & Bögeholz 2005, in press).

Empirical research on this new type of interdisciplinary biodiversity education is still relatively rare. For example, natural science teachers often lack the necessary social science background to tackle the interdisciplinary teaching challenges (Gayford 2000). Another study investigated subjective theories on biodiversity loss among students. Students tend to reconstruct the loss of biodiversity either exclusively in ecological or in social terms (Menzel & Bögeholz in press). If asked to justify decisions on alternative options for the protection of ecosystems, students regard aesthetic arguments as inappropriate in comparison with ecological justifications (Barkmann & Bögeholz 1999). The few empirical studies on the subject indicate that even the most basic knowledge on tools or procedures to integrate facts and values systematically is missing.

For strategic considerations on future research and practice on biodiversity education, these findings should be taken into account. Based on the OECD-PISA (1999) definition of scientific literacy and the competence based PISA assessment procedures, competence models from ESD need to be adapted to biodiversity issues. Such models, e.g., focus on informed decision-making. They consist of a matrix of dimensions (sub-competences) and competence levels that define a developmental perspective (Eggert & Bögeholz submitted). Ideally, biodiversity education curricula are founded on such competence models. For most European countries, a closer collaboration of educational scientists and teachers in developing, testing and evaluating biodiversity education tools would greatly benefit educational research and practise.

RE: Conceptual and empirical approaches to Biodiversity Education

Mauri Åhlberg, E-Conference Chair, University of Helsinki, Finland.

The main conclusion of Susanne's contribution is: "The core challenge of a – necessarily! – interdisciplinary biodiversity education consists of fostering competences for a systematic integration of facts and values regarding non-trivial real world decision-making." I would like to enrich these ideas a little bit. First the idea of what is fact and how it differs from ordinary scientific knowledge is very important for Biodiversity Education. It may be that there are few facts, but plenty of tentative scientific knowledge. Science for me is a collaborative knowledge building process. For example a claim that a species has disappeared from a certain country, can be reversed very soon, when it is found again. Or when certain species, for example sparrow disappear from a certain region, many other species may be invading. Srivastava & Vellend (2005, 270) ask: "Is biodiversity really declining? A balance of extinctions and invasions at different scales (?)"

I think that biodiversity education would be best served as a collaborative knowledge building, where we may find together that we have knowledge, even scientific knowledge, but very few undisputable facts. It is the very nature of complex real world problems, and of science itself, as the best-known method to create knowledge.

In Susanne's excellent contribution, the theme of facts and values is very important for me: "One central interdisciplinary challenge is posed by the problem to systematically integrate facts and values for real world decision-making in the face of factual and ethical complexity."

As I wrote already in my earlier note, I think that there are actually very few facts in science and science education. For me all human knowledge is tentative, prone to continual theoretical and empirical testing, and then improvable. Values in biodiversity education, probably must include at least, life itself, as a meta-value. Without life there would be no other values. Why then is diversity of life, biodiversity, valuable? In my mind, each organism has to think from viewpoint of its own survival and satisfaction of its vital needs. There are plenty of researchers who are not happy with the concept of need. However, as far as I have experiences of growing plants and following animals each species have its specific needs to thrive. I have developed a theory of good life, based on this idea. If organisms' real needs are optimally satisfied, they are thriving, they have good life. It is question for empirical research to find out what are real needs of each species, and subspecies etc.

Where do values come? How we get values concerning biodiversity? I have a theory that integrates knowledge of the world and what we value in the world, e.g. biodiversity and biodiversity education. Based on our knowledge of the world, and real needs of its organisms, human beings, humankind has created and is creating theories what is worthwhile, valuable, Abstract level objects of these theories are called values: life, truth, beautifulness, good, good life etc. Biodiversity has also value aspects. For many of us, it is valuable, much more than desirable, there is rather plenty of biodiversity than less of it. There are basic ecosystem reasons for regarding biodiversity as good, as valuable; aesthetic reasons are involved, and most of us probably prefer as truthful knowledge as possible, also in biodiversity education issues. This kind of knowledge is partly biological and partly created by educational research.

Innovations to promote biodiversity by co-operation of teachers and scientists

Eila Jeronen, University of Oulu, Finland

Summary: The mechanistic worldview has replaced the Renaissance worldview of nature as a living organism with a nurturing earth. This change entailed an ethic of control and domination of nature, and supplanted the ethic of reciprocity between humans and nature. The problems of pollution, depletion, and population expansion have specific roots in each country's internal history, its place in global order, and the current trajectory of its internal development. Each environmental problem therefore needs to be examined in the context of its own specific history as well as its linkages to the global situation.

Status, trends and targets for development of biodiversity education

In 1998, the Commission on Sustainable Development called for UNESCO to develop guidelines for reorienting teacher training to address sustainability. The United Nations has declared the years 2005-2014 as the Decade of Education for Sustainable Development. The goal is to have sustainable development in the educational system of every country within the decade. As the implementation plan is global and general, a separate strategy for the decade in UN's European member states (UNECE Strategy for Education for Sustainable Development) was adopted in Vilnius in March 2005 and many countries have prepared a national strategy, among others Finland.

Consequently, it is time to highlight the role of schools and education in conservation of biodiversity in

- Broadening and deepening understanding on the meaning and appreciation of biodiversity
- Motivating and supporting people to take into account biodiversity as citizens in their everyday life
- Developing the 2010 Programme concerning co-operation between researchers and educators.

Questions to be discussed

Questions, based on development targets, to be discussed in the group "Innovations to promote biodiversity by co-operation of teachers and scientists" are

- What kinds of new possibilities and means do researchers and educators have for creating a many-sided and broad partnership? (e.g. what kinds of co-operational groups are needed? What are the most important administrative work groups for biodiversity and education researchers and experts to participate in?)
- How can biodiversity and education researchers together support educators when fostering and developing environmental awareness at different age levels and in different educational areas? (e.g. what are the most important research issues and questions from this point of view? What kinds of new educational materials could researchers and educators produce together?)
- What kinds of possibilities and means do researchers and educators have for developing the geographical information system (GIS) together?

RE: Innovations to promote biodiversity by co-operation of teachers and scientists

Mauri Åhlberg, E-Conference Chair, University of Helsinki, Finland.

Eila's keynote contribution forced me to think what the underpinnings of Biodiversity Education. What is usefulness of thinking of world views in this context, and are there better options for the named world views? I agree on Eila, that world views are important in practically all aspects of human life (e.g. Koltko-Rivera 2004, Naugle 2002). However, why 'the mechanistic world view' vs. 'the Renaissance worldview'. In my mind, the important difference is between (1) those who take modern science seriously, and regard Earth as a complex system and (2) those who have either very narrow, specific, often everyday thinking view or (3) those who talk about unanalysed Wholes, as Mother Earth etc. I have suggested mainly in my Finnish publications, that there three groups or Worls vievs could be called (1) integrativism, because modern science and science education are integrating, as Susanne in her keynote contribution demonstrates; (2) particularism, because of the focus of narrow viewpoints, and (3) unscientific, over-generalizing holism, which do not care about science, its methods and results. I guess that those who take part in this e-conference have probably the first type of the World View. We all take modern science seriously, as far as I have understood the notes written.

I think that it would be more fruitful to think on concrete terms of human economy, and spreading and disappearing organism species, than abstract terms of World views. Many plant species we now value are from our agricultural past. When economy and agriculture have changed, e.g. meadows have become more rare, and accordingly many of earlier so common flowers and becoming more rare. Humans have always brought with them other organisms. Every organism changes its environment in some way or other. I think that some of the so-called invasive species, threats to biodiversity may be exaggerated. E.g. I personally like Impatiens glandulifera, at least in my garden. I know that it can spread also to nature, at least temporarily. In Finland the damages to original nature are perhaps not so severe, but the situation may be more difficult in some other countries.

One of Eila's questions concerns GIS. In my mind, GIS is a practical tool, and most of us probably feel more relaxed with it, than with abstract problems of World Views, and their potential importance for biodiversity education. As regards to GIS, I think that it is becoming very important also in Biodiversity Education. I do not yet have own experience of GIS. What about others? If somebody has experiences on its use and ideas how to promote its use in biodiversity education, they would be very welcome.

Observing Survival or Death of the Austrian Orchids in the 3rd Millennium

Dieter Armerding, Österreichisches Orchideen Netzwerk (ÖON) and Bioskop, Journal of the Austrian Biologists Association, Austria

Summary: The monitoring of population changes in Austrian Orchids is proposed as a contribution to the attempts to stop the loss of species in this country and should involve school teachers and students in order to educate future generations about the importance of biodiversity to life.

Orchids represent the largest family of monocotyledonae and with more than 20,000 species they are also the largest group of flowering plants. Orchids fascinate scientists because there are almost no fossil records. So far there has been insufficient research particularly since many species occur in distant tropical areas hindering more intensive studies. In the past scientists restricted themselves to a descriptive characterization and classification of the plants and only recently have molecular techniques for defining phylogenetic relationships been introduced. The progressive loss of species globally will limit or prevent the uncovering of many of the orchids' secrets.

More than any other plant species orchids also captivate laymen and non-scientists. The reason for this interest is mostly aesthetic but the rarity of orchid species also increases their fascination and this enthusiasm about orchids is also reflected in an ample and diverse supply of literature. Unfortunately, Austria has only designated two orchid species to deserve more attention with respect to population changes and conservation in the European list of plants (Natura 2000): Lady's slipper (Calceolus cypripedium) and the Fen Orchid (Liparis loeselii). Furthermore, the Austrian government has so far neglected to invest major efforts in the protection of plants on the Red List. Hence, there is an urgent need in this country to limit the loss of plant and other species. Meadows and pastures are of special interest. Such habitats are particularly rich in species including orchids as well as other imperiled plants and animals. These are usually final retreats for these species and are subjected to a great variety of dangers including the change of agricultural methods or giving up farming and use of the land altogether. In the worst case the total destruction and misuse of natural habitats occurs.- Orchids are excellent indicators for most ecologically valuable areas, which, however, are continuously diminishing. The same applies for forests. Only sustainable and extensive use of forests or in some cases no use at all can guarantee the survival of orchids and other threatened species living there. It is, therefore, extremely important to observe and evaluate the development of orchid populations of the approximately 70 Austrian orchid species over a period of time. Much data on orchid habitats in some of the Austrian states exist already. They do, however, only illustrate a static situation in the past. The data are also kept secret to an extent which makes them useless for planning strategies for future protection and survival of the orchid populations and their habitats. The monitoring of orchids during the coming years will possibly uncover negative populations changes and causes for the loss of species. In the future this would allow measures for protecting species and their habitats.

An NGO called "Österreichisches Orchideenschutz-Netzwerk" (ÖON, Austrian Network for the Protection of indigenous Orchids) was founded in late 2005. ÖOM is supported by most of the relevant Austrian NGOs including: WWF Austria, Birdlife Austria, Österreichischer Naturschutzbund, Österreichischer Alpenverein, Österreichische Orchideengesellschaft and others. The ÖON will develop alternative

and innovative ways of protecting species and intends to complement the activities of other NGOs who have implemented projects for the monitoring and protection of other species. As an important aspect of their activities the ÖON plans the integration of schools in conservation projects but it will be necessary to motivate and educate parents and teachers as well as students. Most importantly, today's children will in future bear the consequences of our past and present actions and it is high time that they learn what to expect. We need to educate the children to confront the dangers and hopefully prevent the worst - to reverse the negative trends and the impact of environmental destruction and to try to repair and restore the natural habitats. Orchids are ideal tools with which to teach a variety of concepts relevant for environmental protection. Projects, such as the orchid monitoring, will bring the children in close contact with remaining natural environments. They will learn about and understand about the mechanisms of evolution, the global distribution of plants, the function of ecosystems, about modern systematics – including molecular phylogenetics, and about the importance of the preservation of all species and their biospheres. The children should understand and appreciate the importance of such concepts since an intact environment not only guarantees the survival of species but also that of mankind in a world worth living in. The ÖON has the necessary knowledge for such a schooling and the scientific and other contacts needed for a successful assignment. They could also make use of other global programs which exist. Those include in particular the educational strategies of the UNESCO and the American Museum of Natural History in New York.

Figure 3. The lady's slipper orchids are plants of European interest (Natura 2000). Their common threat are people who pick the flowers or who dig out the whole plant. Forestry, however, has also contributed to extensive loss of these plants. Education of people and studying the orchids and telling the foresters what to do will help to preserve them.
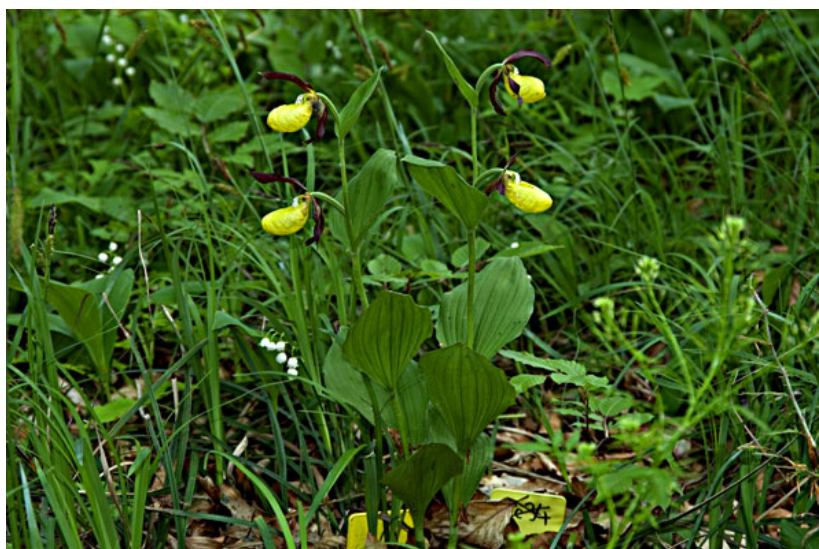
Figure 4. School projects may help scientists in their research. Studying orchids (here *Dactylorhiza sambucina*) in their natural habitat will also educate children with respect to the ecological needs and the development of the plants.

Figure 5. Monitoring of orchid populations means first of all counting! But this is fun. Members of the ÖON are observing a variety of different orchids in a meadow in Tyrol in June this year. Survival of the orchids requires strict measures: mowing late in the year and no fertilizer.

Figure 6. Some orchids grow only in forests. Wood can still be harvested. But the trees' canopy should still be able to keep direct sunlight from the plants. We need more empirical data and research to find out what orchids and other endangered plants really need.

RE: Observing the Austrian Orchid

Mauri Åhlberg, E-Conference Chair, University of Helsinki, Finland.

Thanks Dieter for your lovely keynote contribution. I love flowers, and I enjoyed your expert contribution. It is important to take care of each interesting organism group. There are many persons who have a keen interest in them. Their positive energy ought to be promoted for public EU good.

In particular, I am thinking how best we could promote the conservation of orchids, and all other kinds of threatened species in the EU and globally. Our main focus in this group is Biodiversity Education. As we have have seen already many times, it is not just Youth and Biodiversity, but also life long learning for Biodiversity and Sustainable Development. Families and parents are important, as also individuals regardless of age, sex, and race.

Dieter has photographs of (1) individual flowering specimens, (2) of biotope, and (3) of humans, orchid specimen and biotope. Our vision in becoming NatureGate® network of servers includes similar resources. For sure, these servers could be called Virtual Floras, or Virtual Biodiversity, or any name that comes into your mind. The point is, that it would be a common benefit for living nature, our environment and well-being, to create a EU or even global network of servers to promote (1) sharing of biodiversity and sustainable development information, and (2) to promote biodiversity education and Education for Sustainable Development.

Do you have similar broader initiatives in your organizations and countries? I guess that in the EU we have plenty of expertise, ideas and materials, photographs, videos, etc, that could work together far better than has happened earlier, to promote Biodiversity Education and Education for Sustainable Development. Are there any real possibilities of co-operation, and getting funded together? EU funds are available to us, but nobody can get any of them alone. In my mind, we'll need much more R&D cooperation to promote Biodiversity Education.

Eila Jeronen, University of Oulu, Finland

I think that you are right in saying that parents should also be involved in promoting biodiversity education. In the Finnish National core curriculum for upper secondary schools (students aged 15-18) outlines on page 14 that: "Learning is bound to the activity, situation and culture in which it takes place" and on the page 18: "Students´ parents or guardians must be provided with sufficient opportunities to familiarize themselves with the work of the upper secondary school. Coo-operation with the parents will support the prerequisites for study as well as the health, safety and well-being of students.

Co-operation between home and school must be organized so as to provide students with support in questions concerning both studies and well being and in any possible problem situations. The educational institutions must be proactive in initiating co-operation. The section of the curriculum concerning co-operation between home and school will be specifically drawn up in co-operation with authorities responsible for the implementation of municipal social and health care services."

The Biology syllabus states on page 134: "Biology instruction...must also provide a foundation for understanding the opportunities of the life sciences to promote the well-being of humanity, other living organisms and living environments. Instruction will develop students´ scientific thinking, arouse their interest in the life sciences and encourage them to behave in an environmentally responsible manner so as to sustain natural diversity." In a compulsory course named "Organic world" there is a theme "Manifestations of natural diversity" which includes topics such as diversity of ecosystems and species, animal behaviour as a manifestation of diversity and genetic diversity. In a specialization course named "Environmental ecology" there are for instance objectives to understand the significance of biodiversity to the future of humanity and to develop environmental literacy of students, understand their responsibility for the state of the environment and know how to act in accordance with the principles of sustainable development.

In the National core curriculum for basic education the co-operation with parents is underlined (p. 20). The main ideas are similar to upper secondary schools. It has been written that home-school co-operation gives more information of pupils to teachers and helps teachers to plan and implement instruction based on the needs of pupils. The co-operation should be continuous starting at the pre-primary education and various modes of co-operation that support dialogue between home and school should be developed. The parents or guardians must have an opportunity to discuss the questions and possible problems associated with the pupil's education. In forms 1 to 4 (aged 7-10) important objectives are for instance that the pupils learn to obtain information about nature and environment and learn to protect the nature and to save the natural resources. The pupils study this kind of behaviour for instance in the theme "Organisms and living environment". In forms 5-6 (aged 11-12) the whole biology and geography education emphasizes responsibility, the protection of nature, and the preservation of living environments. It also supports the student's growth as an active citizen to a sustainable lifestyle. Biodiversity is one of the core contents. In forms 7-9, instruction focuses on the interactive relationships between people and the rest of nature, and human responsibility for protecting natural diversity. "The common environment" theme includes for instance studies on ecologically sustainable

development and investigations on the status of, and changes in, one's living environment weighing one's environmental behaviour. Especially in these kinds of themes, parents can participate in processes actively. Sometimes they visit schools, sometimes they participate in projects, excursions etc.

What do you think are the best ways to activate the parents?

Priorities for Biodiversity Education

Mauri Åhlberg, E-Conference Chair, University of Helsinki, Finland

I would like to stress importance of first two themes of our e-conference:
(1) Innovations to promote biodiversity education through the co-operation of teachers and scientists.
(2) Schools as activators of the monitoring of environmental change and biodiversity.

I think that during our e-conference we have already found many innovations how to promote biodiversity education through the co-operation of teachers and scientists. And actually also at least implicit ideas on how schools could act as activators of the monitoring of environmental change and biodiversity.

There are two items, which I learnt today and want to share with you. Both have implication to both of themes above:

(1) Spencer-Jones & Cutlle (2005, 234 – 235) show how British wild flowers are helped to thrive on motorway embankments and "waste lands" in the urban environment. At least those waste lands that are near roads and streets could in this way creatively used for habitats for wild flowers and organisms that depend on them. On the other hand "waste lands" are often biologically full of otherwise interesting plants, butterflies and other organisms. But they are often not so beautiful as are flowering meadows. In a couple of parks in the Helsinki area, dry meadows have been created. I wonder if schools, teachers and pupils could do any more than learn and discuss these cases. On the other hand as active citizens they can at least provide initiatives to create more these kinds of wild flower meadows.

(2) Janzen (2005, XII) agrees that we need more images on the web, more websites, more species pages, more maps. "Those are necessary collaterals but not sufficient." Janzen (2005, XII) wants "a process that will for the first time connect the collective species-level biodiversity of the world to any and all users, on the spot now. Fast, cheap, and on-site single (or very view) gene sequencing –developed for the purpose of identification-has the potential to deliver the species-specific linkage between the species and its human-known collaterals." If that kind of wonderful tool would be created one day, I guess Biodiversity Education would also be greatly improved.

I have suggested similar idea to Jouko Rikkinen, who is a Professor of Plant Biology at University of Helsinki. He presented reasons why it may be extremely difficult, and probably will take decades before we have those kinds of fast DNA-based species detectors. The lesson: Although more and better images on the web, more and better maps, and more servers may not be the perfect solution, they can be implemented today, if only funds are allocated for that purpose. If we use both inquiring learning and collaborative knowledge building, plenty of far better than current Biodiversity Education and learning, better than current reasoned actions for maintaining and improving biodiversity would probably be taken. Biodiversity web servers as described in the notes of this e-conference, would promote Biodiversity Education today, not after decades.

RE: Priorities for Biodiversity Education

Keith Hiscock, Marine Biological Association, Plymouth, UK

Mauri Åhlberg asks about access to biodiversity information for education purposes especially via the Internet and several people have e-mailed ideas.

The public are fascinated by the seashore and school children find 'rockpool rambles' and 'seashore safaris' extremely enjoyable - often because they see such bizarre creatures compared to day-to-day terrestrial life. A particular feature of seashores is that ecological gradients (linked to the rise and fall of the tide - well, in the Atlantic at least) can be demonstrated without having to climb 3000m up a mountain. There are also principles of refugia, importance of grazing, shelter etc that are easily understood on the shore.

We, at the Marine Biological Association in Plymouth, have developed several projects and information resources on marine biodiversity and threats to it. Most recently, we have developed a project that links to the school curriculum and majors on finding climate change and non-native species - the 'Shore Thing'.

I have no doubt that we are 'not alone' and that there will be many places in Europe that find the seashore an excellent location to enthuse children about biodiversity and to help them develop a good attitude to protection of biodiversity. Do look at www.marlin.ac.uk/learningzone and let us know about the resources you use.

School-initiated local sustainability projects in co-operation with an interactive national biodiversity database

Adrienne Ortmann-Ajkai, Hungarian Society for Environmental Education and Attila Varga, National Institute for Public Education.

Nowadays people in European countries live mostly in man-made habitats, so there is a gap between them and Nature. Every educator, who aims to teach about nature - which is one of the bases for education for sustainability - has to solve two tasks before beginning to teach: to bridge the gap and to motivate learners to go through the bridge. Bridge the gap: start where your students are (hanging on the web): a special website on Nature, which contains information on our nature, "our backyard". Motivate to go through the gap by learning "at the other side of gap": local practical and/or scientific students' projects in cooperation with adults of local communities and with database building scientists.

This special website can be Hungary's National Habitat Database website (MÉTA) - www.novenyzetiterkep.hu MÉTA Database, covering the whole of Hungary, was created between 2002-2005 based on 7000 days of fieldwork carried out by 210 local experts, organized by the Institute of Ecology and Botany of the Hungarian Academy of Sciences. Units of European Flora Survey, for more precise localization divided into a systematic grid of hexagons 600 metres wide, were used as pixels. Habitat lists (70 types) for each hexagon were recorded, together with habitat attributes: area, naturalness, landscape-ecological attributes (e.g. pattern, connectedness, isolation), land-use (e.g. grazing, field abandonment, forestry practice), most typical threatening factors (e.g. lack of water, invasive species, pollution). Collected data (more million) were organized into a GIS database supplemented by MS SQL query system, and can be visualized by mapping programs, e.g. ArcView. MÉTA database is available on-line for many user groups, e.g. for environmental and ecological research, nature conservation, developmental projects of different scale, decision-makers, local communities and of course for teachers and their students.

Further development of the database aims to create an interactive Hungarian Habitat portal with a variety of well-structured, easy-to understand and easy-to use educational background materials, with maps and photos, well suited to different teaching and learning styles.

Already, the MÉTA database offers many possibilities for education, for sustainability and other environmental projects, local conservational projects, for teaching ecology and geography, and developing digital literacy. In order to survey and realize these possibilities, a program called "Local MÉTA workshops" has been launched in collaboration with the Hungarian Society of Environmental Education, one of Hungary's leading EE NGO. Local MÉTA workshops are students' groups led by a teacher and supported by local MÉTA expert(s). The workshops are aimed at students who are:
- Discovering an environmental issue in their neighbourhood
- Studying it using MÉTA database and field work
- Doing practical conservational work for maintaining local natural values, in cooperation with local authorities and adults
- Doing scientific projects, connected to mainstream research based on MÉTA, helped by MÉTA experts, partly for participating in students' contests

- Providing data (collected by scientific MÉTA methodology) for actualising the database.

Local MÉTA workshops are being formed in and around Budapest and in southern Hungary, in primary and secondary schools, universities and NGOs dealing with local sustainability.

Figure 7. The MÉTA framework
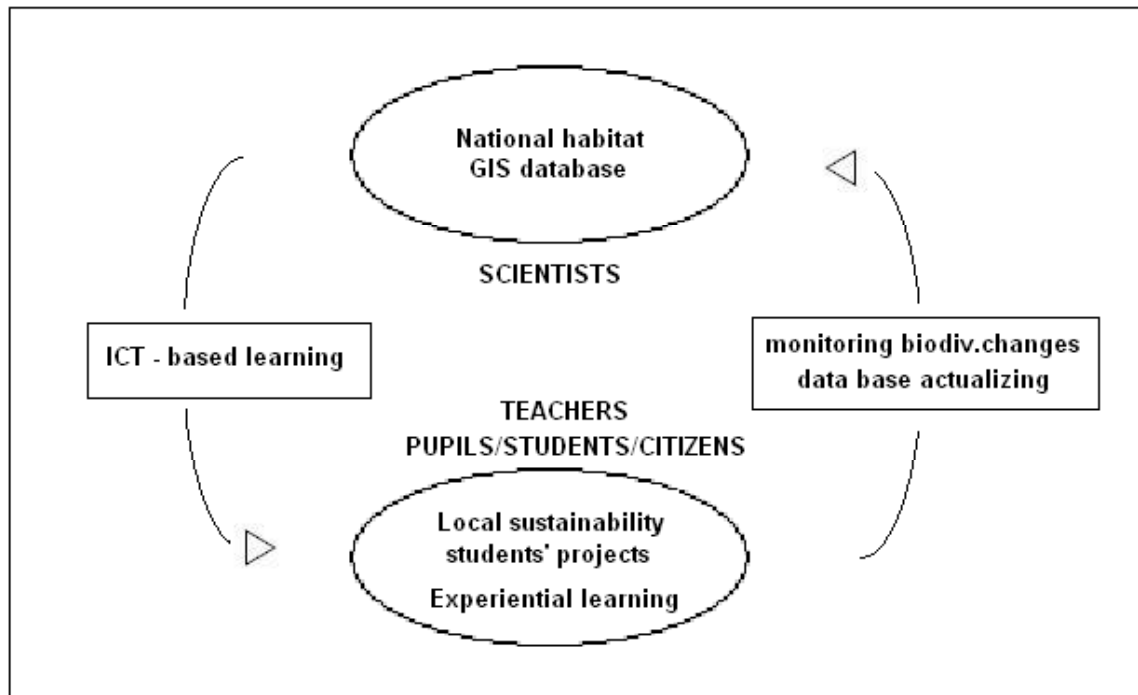
Summary of research priorities identified in Week 1

Juliette Young, CEH Banchory, UK

Recommendations discussed in Week 1 of this session have included:

- Increase interest in biodiversity by using particular charismatic species (e.g. orchids) or habitats (e.g. rock pools and seashores) to encourage practical Biodiversity Education.

- Promote competitions on European Biodiversity among schools (including the public)

- Use of non-traditional approaches to Biodiversity Education, such as WAP Browser technology in mobile phones for mapping and/or species identification, GIS, the use of handheld GPS and the BioBlitz initiative of counting as many species from as many taxonomic groups in a 24-hour time period.

- Develop ways to store, share, use, distribute, and continually further develop the results of both competitions and collaborative knowledge building using modern computer soft ware for collaborative knowledge building, e.g. CmapTools.

- Promote closer collaboration of educational scientists and teachers in developing, testing and evaluating biodiversity education tools would greatly benefit educational research and practise.

- Promote the involvement of parents in Biodiversity Education

- Develop methods to easily deliver and access biodiversity information for all citizens of EU.

- Encourage the use of databases (for example the MÉTA Database) in Biodiversity Education to help teachers bridge the gap and motivate students to learning "at the other side of gap".

A few questions raised in contributions include:

- What kinds of new possibilities and means do researchers and educators have for creating a many-sided and broad partnership? (e.g. what kinds of co-operational groups are needed? What are the most important administrative work groups for biodiversity and education researchers and experts to participate in?)

- How can biodiversity and education researchers together support educators when fostering and developing environmental awareness at different age levels and in different educational areas? (e.g. what are the most important research issues and questions from this point of view? What kinds of new educational materials could researchers and educators produce together?)

- What kinds of possibilities and means do researchers and educators have for developing the geographical information system (GIS) together?

German experience of public biodiversity education – using butterflies and other selected animal taxa

Karin Ulbrich & Josef Settele, UFZ - Centre for Environmental Research Leipzig-Halle, Germany

Summary: After communicating biodiversity research over several years, we have received a lively and diverse feedback from the society as a whole. However, when distinguishing the target groups according to their age, we found that students from 16 onwards responded to our activities to a lesser extent than the others. In cooperation with teachers and visitor centres we develop an approach for further implementation of biodiversity issues in young people education and avocation.

In 2005, the "Adventure Butterfly" campaign, organised by the TV (ZDF), a German nature conservation NGO (BUND) and UFZ (Centre for Environmental Research Leipzig-Halle), was broadcast throughout the year on several TV and radio programmes and with a print run of more than 30 million. The movie "Bye, bye Schmetterling (Butterfly)" was displayed many times at regional events and is being translated into English following great demand. Several tens of primary school classes took part in a competition for best butterfly knowledge and conservation actions. In addition, since 2005, the German butterfly monitoring has been organised by the UFZ. A first analysis shows that over 50% of the participants are over 50 years old, and only 5.6% are younger than 30.

In a current project, we give a great deal of consideration as to how we could communicate biodiversity concerns specifically to the younger generation. This project includes the development of model-based educational software which is freely accessible via internet, and its implementation in preservation management. Using solitary bees, butterflies and amphibians as examples, we demonstrate the species – habitat relationships with individual-based models extending the output to the population level. Individual-based simulation models are appropriate tools to communicate animals' behaviour in the habitat as they consider the important (in the focus of the question) processes and aim to be as mechanistic as possible.
We found that:
- Environmental visitor centres are excellent mediators by involving biodiversity educational software in their programmes and by combining them with practical conservation measures.
- Teachers' qualification courses offer a good forum for brain storming. They help to specify questions and approaches for introducing software and for stimulating students to use it individually beyond school lessons.
- The composition of student theses with duration of one year (which is common in special grammar schools in Saxony-Anhalt and Lower Saxony) allow collaboration and implementation of the target group's point of view.
- University teachers and students of bio-didactics are indispensable partners to get research concerns across to learners.

In this context we would like to share experiences in biodiversity related dissemination to and collaboration with the public. In particular how to best reach the generation(s) that will surely have an enormous impact on how the state of biodiversity will develop in the future.

A common platform for biodiversity education?

Ferdinando Boero, University of Lecce, Itlay

I greatly applaud this Youth and Biodiversity initiative, because the future voters will choose the right politicians (hopefully) and they have to know what to ask them. Biodiversity and the environment in general are far from being covered in traditional education in Italy. They are simply not covered (or poorly covered) by the official programmes of all types of school. The Italian Society of Ecology is sensitive to this problem and is now acting to produce documents that will be used to push our ministry of education so to put more focus on environmental problems in the curricula of all schools. At present such topics are present in the textbooks but they are often skipped by the teachers.

The main focus is on mathematics, the rest is considered as anecdotal. On the other hand, lots of information is available on the TV, but only on flagship species treated as some sort of pets (from whales to lions) and not much emphasis is given to the role of biodiversity in the functioning of the planet. The Italian Society of Ecology copied the initiative of the British Ecological Society that, some decades ago, asked its associates to list the important concepts of ecology. Besides the ecosystem, which ranked first, the rest of the Italian responses covered a random assemblage of concepts. Our aim was to find out what might be a basic programme to suggest to the ministry. If we have to teach biodiversity and ecology in schools, do we have a series of key issues we agree upon? The exercise is not trivial. Ask one hundred scientists and you will have one hundred different answers.

It might be interesting to know what are the levels of literacy of our students on these issues (country by country) and then, since the problem is global, to suggest a common platform that should be used across the whole Europe. If they say "Great! We buy it!" then what will we sell them? Do we agree on the priorities and how to explain them? Are we able to prepare the index of some sort of textbook for pre-university schools that conveys a message we agree upon?

Kids ask strange questions. If you say that species are important and we have to protect them, they ask why then we are trying to get rid of rats and mosquitoes? Then it comes out that SOME species are to be protected and some others are to be eradicated. The message is not so clear-cut. Invasive species are a curse, but then some become resources and we eat them, so at the end the message is that there are good species and bad species. Tomatoes (and many other species we eat) were aliens to Europe in the first place. Again, the message is not so clear-cut.

Young people and biodiversity: Worlds apart?

Jana Verboom, Wageningen University and Research Centre, The Netherlands

Current education and leisure patterns lead to ongoing alienation of young people from nature. Scientists and teachers have the duty to join forces in teaching young people to understand and appreciate biodiversity.

Nature plays a minor part in the lifestyle of the young people of today as their free time is taken up by computers, games, television and other multimedia. We run the risk of bringing up a generation that does not care about the conservation of biodiversity. It has been demonstrated that British children knew more about Pokemon TV characters than about real animals and plants with which they share the country (Balmford et al. 2002). German children do not know the colours of common flowers and animals and are not enthusiastic about outdoor activities (Braemer, 2003). Dutch children rarely visit nature and have no clue about native wildlife (Verboom et al. 2004). One of the problems is that school curricula are centred around reading, writing and maths skills, and subjects such as nature education have low priority. Furthermore, children learn about a broad range of biological aspects, from assimilation and digestion to the parts of the body, but biodiversity education is mostly lacking. Last, they learn from books, not from experience, as excursions into nature are rare due to all sorts of practical and financial constraints. Many young teachers, moreover, "can't tell a blackbird from a sparrow", being themselves raised in the multimedia era.

How can this negative spiral of ongoing alienation be broken? First, knowledge is necessary about the state of alienation in different parts of Europe and relations with educational programmes should be revealed. Does a week in the forest add more to the understanding and appreciation of biodiversity than a weekly program on school TV? How do quantity and quality of nature education relate to understanding and appreciation of biodiversity? Can the so-called "significant life experiences" be triggered? Second, top-down processes should be mobilised to put biodiversity education higher up on the priority list. Governments should realise that if no action is taken, the next generation may lack interest for biodiversity conservation. Scientists have the responsibility to communicate the problem to politicians and policy makers. Third, bottom-up processes are necessary where scientists and teachers take the initiative to work together. As an outcome, groups of children will be intensively involved in some science project in their own neighbourhood, either contributing to field work, or just being informed and having a good time, experiencing that nature is not so boring after all and biodiversity is important to conserve. Because experts can open the eyes to the wonders of nature of those who were blind before, only vaguely aware of a green surrounding, without paying attention to all the animals and plants.

E.O. Wilson launched the Biophilia hypothesis suggesting that we are all born with an innate love of nature (Wilson, 1984). It is the responsibility of teachers and scientists together to keep this love alive.

RE: Young people and biodiversity: Worlds apart?

Mauri Åhlberg, E-Conference Chair, University of Helsinki, Finland

I enjoyed reading your keynote, but at the same time I found it a little bit pessimistic. I agree with your research data. On the other hand many of us have observations and data of our own. We agree that often pupils know very little about species and biodiversity in their neighbourhood. As you say there are many reasons: fashion, culture, lifestyle, TV, Internet, multimedia, international goals of science education neglecting species recognition and biodiversity etc. These issues have also been demonstrated in the doctoral dissertation of plant species recognition by Ms. Arja Kaasinen. She has also shown that, at least in Finland, year after year pupils on average are able to identify more plant species. This justifies optimism.

However, thinking positively, all these listed aspects could be changed for the better, if we had an excellent web server full of extremely good, aesthetically pleasing photographs and videos of local organisms and ecosystems. Schools and people of all ages would enjoy and use them. It would be even better, if pupils and all other people could go outdoors. Anywhere, even in urban environment, there are plenty of organisms to be observed in their surroundings. Everywhere there are plenty of organisms. People could start actively taking their own photographs of species, and use a fast and reliable software package to identify the species they have found. During Linnaeus' time, it was very fashionable of study plants, and other organisms. It may become a fashion again. Fashions change in a fluctuating way. Nowadays, there are big companies who would like to pay to create a greener, more nature-friendly image and hopefully sustain it. They would probably pay to be named as sponsors of these excellent servers. As Wilson (1984) claims and many other researchers have demonstrated, we belong to nature, most of us love other organisms. We relax in beautiful and non-threatening natural settings, biotopes, ecosystems. There is a plan to create those kinds of servers for biodiversity education, and biological and sustainability education in general. They would not cost too much. In the R&D project I am involved they are called NatureGate®.

I agree with Jana that we need those politicians who have power and money to invest more into biodiversity education and research. But not any kind of education, not only delivering facts, and values, but empowering pupils, teachers, all citizens for inquiring learning and collaborative knowledge building, taking their own digital photographs of species and biodiversity, and hopefully sharing them with other people.

In the emerging global knowledge society we need (1) inquiring skills, (2) creativity, and (3) ability to create knowledge collaboratively. For sure there are many other skills, abilities, and capabilities that ought to be enhanced in education. In educational research we often spend long periods of time thinking and discussing educational objectives, upon which R&D work is building. We could start from official curricula, but often there is very little or nothing about species and biodiversity issues. In this e-conference we probably agree that all citizens ought to learn at least the most important species, what ever they are in each context.

Juliette sent an email to me asking me stress on importance on research on biodiversity education, and whether there is a possibility to create a EU R&D project on Biodiversity Education. What are you thinking? Is there a chance for common EU R&D project on Biodiversity Education?

RE: Young people and biodiversity: Worlds apart?

Marja-Leena Loukola, Finnish National Board of Education

Thank you for your very important keynote. The questions how to make ongoing alienation from nature arrest and how to raise understanding the prerequisites for human well-being, necessity of environmental protection, and the relationship between the two, are crucial.

Biodiversity education and education for sustainable development have an obvious position in the Finnish national core curricula in all levels of education and we have prepared Strategy for Education and Training for Sustainable Development and Implementation Plan 2006-2014 by the sub-committee for education of Finnish National Commission on Sustainable Development. After all we can find alienation from nature and the lack of understanding the significance of biodiversity.

We need new methods and viewpoints and training in taking responsibility for biodiversity in our every-day life and in working-life as well. To find out new innovations we need co-operation between researchers, policy-makers, teachers and NGOs.

RE: Young people and biodiversity: Worlds apart?

Per Sjögren-Gulve, Swedish EPA

I definitely agree with Jana Verboom's contribution. Too many people have the view that one needs to know a lot about nature to be able to enjoy it. Likewise, that one needs to know a lot about nature and species to be able to show them to children. This is not true. The important thing is that you discover nature and "live it" together. This is the basic philosophy of Joseph Cornell (www.sharingnature.com). I think that the premises for discovering nature and species, and their ecology, are far better today (by combining outdoor discoveries with use of the Internet) than they were ten years ago; see for example www.artportalen.se/default.asp. Of course, this varies among countries. In my family, combining outdoor hiking with taking digital photos, some of which can be used for species identification, has also made nature discovery more interesting.

What makes the kids focus on games etc, as most do, is of course a combination of us adults not being the "perfect" role models and the catchy and efficient game- and commercial logic of the game manufacturers.

I agree that lots can be done. A first thing is to go out and enjoy and discover nature together - and scientists can add lots to this discovery. Children learn spontaneously - "flow learning" - traditional teaching shouldn't be emphasized too much.

RE: Young people and biodiversity: Worlds apart?

Ben Sunderhaus, NAJU (Naturschutzjugend im NABU Deutschland), Germany

First of all the NAJU (Naturschutzjugend - more on www.naju.de) has made an effort to combine old-style Programmes like Cornell (1980s-90s) with new kinds of programmes, stemming from the very heart of actual youth culture. While evaluating the old campaigns for youngsters in Germany we had the (bad) experience that:
- Young people are interested in ecology but will not take action (for example: they learn about climate change at school but do not take action)
- Interest in new technologies is more attractive than in so called "authentic contact with nature"
- If there is interest in nature/ecology, this interest is briefly linked to the social status: children of well-educated, richer families (who are interested anyway), take part. Children of a lower social or education status only took part when school-teachers forced them to do so.

Facing these problems we have re-designed our concepts. Before it worked like this

A) You can take part in our game, we set the rules and you'll receive a reward.

This old style campaign worked well in schools but not outside school. It failed because it was not really open to new ideas and would degrade children to clients of our (well or badly designed) forms of action.

In 2000 we developed a new kind of campaign that combines off line local action and online-point-systems (more or less like in sports) it worked like this:
A) We give you some kind of topic or frame, a game (very similar to the level-system of a PC-Game) and some rules.
B) You can take part with your own ideas (local group), for example using self-made ideas gives you a bonus.
C) You have chance of winning when you are creative, use the bonus-system (quality of action) or if you are working very intensively (quantity) and you get more points than other groups.

We did not want to support only online-action (fake interests and no local action), but rewarded real life action within new virtual media.

It was a new kind of campaign and in the first three weeks we had only 4-6 groups but after that the number of interested people increased to 70 groups. We have also had young people of lower social status and low interest in urban ecology taking part. While www.die-entsiegler.de was focused on urban development the following (actual) campaign focuses on hydrology and rivers: www.fluss-connection.de.

Communication technology, urban life style and biodiversity

Jari Lyytimäki, Finnish Environment Institute

Summary: One important gap in our current knowledge is how to connect urban life style of young people with biodiversity protection. Studying and developing the use of new communication technology may provide a key answer.

Two general level trends relevant for the theme 'Youth and Biodiversity' are brought up here. Firstly, the majority of children and young people in the European countries live in urban environments, even in sparsely inhabited countries such as Finland. Cities and other urban areas provide usually only limited possibilities to experience natural habitats and learn about ecological processes. However, because of the growth of the built-up area, urban environments are increasingly important in biodiversity protection.

Secondly, messages delivered by electronic and print media are strongly shaping our views about the reality. Young people especially are intensively using various kinds of electronic media to receive information and communicate. Rapidly evolving communication practices can be considered as a key constituent of urban lifestyle.

Nature experiences are increasingly constructed and delivered by the mass media. Personal experiences about nature are also strongly conditioned by images from TV-documentaries, news and other mass media. Internet provides a variety of new possibilities to experience nature on-line. For example, we can take a look into the life of osprey and cormorant in the Finnish coasts, or we can dive under the waves of the Baltic Sea (see: http://natureit.net/index.php?page=livekamerat). There are also a variety of more interactive portals providing possibilities to express an opinion, ask advice and discuss (Finnish example: http://ikkunasuomenluontoon.fi/).

Environmental education has largely focused on creating and fostering personal relationship with nature especially by learning in the environment. However, within the context of urban information society, such educational efforts face the risk of providing only exotic curiosities, rather than an understanding about the complex interaction between everyday social realms and ecological systems. In order to be effective, the environmental education must be genuinely linked to the urban lifestyle.

What kind of new avenues there are available to motivate learning? For example, digital photography, web pages and geographical information systems can be combined to motivate school students to capture, present and analyse urban biodiversity. These kinds of efforts can serve both media education and environmental education. They can motivate those pupils interested in technology, but not on nature. In the long run, they also can provide new kind of material to monitor environmental change and to compare development in different locations.

I would like to use this opportunity to ask the participants of this e-conference to share their experiences and ideas about how to fruitfully connect communication technology, urban life style and biodiversity protection.

RE: Communication technology, urban life style and biodiversity

Mauri Åhlberg, E-Conference Chair, University of Helsinki, Finland

Thanks Jari for your keynote contribution. I totally agree with your main conclusion that "An important gap in our current knowledge is how to connect urban life style of young people with biodiversity protection. Studying and developing the use of new communication technology may provide a key answer".

Your criticism about Environmental Education (EE) is appropriate. 2005 to 2014 is the UN Decade of Education for Sustainable Development (ESD). In official documents of the UN and UNESCO, a clear difference between EE and ESD is made. Biodiversity concerns all modern aspects of Sustainable Development, ecologically, economically and socially sustainable development. It is not a question simply of nature experiences, although they are important.

I hope also that participants of this e-conference would share their experiences and ideas about how to fruitfully connect communication technology, urban life style and biodiversity protection and suggest research priorities in this field. I guess that we have very little experiences. Many of us have ideas and visions on how urban life style, biodiversity protection, biodiversity education, and Information and Communication Technology could be integrated. I have already mentioned many times NatureGate® R&D (University of Helsinki) program in which I am personally involved. Do you have similar visions, and Biodiversity R&D programs going on, if not any empirical results?

Biodiversity Education and/or Education for Sustainable Development

Iann Lundegård and Per-Olof Wickman, Stockholm Institute of Education, Sweden

The authors argue that Biodiversity Education should start with open-ended problems that engage deliberation and action in students. They also argue for more research on the various biodiversity problems that could connect with the conflicts of interest that students find meaningful to deliberate and act upon.

Biodiversity Education can be understood either as Environmental Education (EE) or Education for Sustainable Development (ESD). EE often starts from environmental problems as formulated within the relevant fields of science (particularly biodiversity and ecology). It then assumes that such knowledge will encourage attitudes of environmental awareness that in turn would result in action to solve the problems presented. As there is little evidence for this linear process, many researchers have argued for an ESD that begins with social issues and stimulates critical deliberation and action in relation to human conflicts of interest (see for example Axelsson (1997); Breiting (1994); Mogensen (1996); Schnack (1998)).

Also recent educational research understands learning and education from a more holistic perspective, where the learners' attitudes, knowledge and actions are not easily reduced to separate entities of a causal chain, but rather are entwined in the lives and actions of the students (see for example Lave (1996); Wertsch (2002); Wickman (2006)). One could thus say, that ESD to a larger degree acknowledges these latter educational results. The question here is whether we should approach Biodiversity Education as EE or as ESD. As will become apparent, this question deals with the position of biodiversity education in general education.

In a recent study we interviewed seven high school students in depth about their thoughts on environmental questions (Lundegård & Wickman, in review). These students attended a special environmental education course. The conclusion we can draw from these interviews is that in discussing environmental questions with high school students, conflicts of interest are a recurring, common theme and in need of deliberation. In all, we identified 132 such conflicts of interest in the interviews. None of the interviews came to deal with questions about scientific facts. Instead the students repeatedly returned to conflicts of interests dealing with values. One example was the overarching question whether we should give priority to environmental efforts or to stopping things like poverty, famine and AIDS. An example of a more personal conflict was whether the family should take the train instead of the car. Although the answers to such questions also require scientific facts, the students took values and conflicts of interest as their basis. But there were also numerous questions where values seemed to play an even greater role like: Should the politicians or the market guide development.

Our conclusion is that Biodiversity Education should start with open-ended problems that engage deliberation and action in students. Rather than asking how knowledge about biodiversity can result in student action, we should ask how biodiversity can connect to the different problems in society that engage students to act. For this reason biodiversity education should be a concern of all school subjects, and all teachers should be given opportunities to develop an understanding of how the problems of biodiversity relate to their field of specialisation. We also need more research on the various biodiversity problems that could connect with the conflicts of interest that students find meaningful to deliberate and act upon.

RE: Biodiversity Education and/or Education for Sustainable Development

Mauri Åhlberg, E-Conference Chair, University of Helsinki, Finland

Thanks Iann and Per-Olof for your excellent keynote contribution. I fully agree with your main conclusion that: Biodiversity Education should start with open-ended problems that engage deliberation and action in students. They also argue for more research on the various biodiversity problems that could connect with the conflicts of interest that students find meaningful to deliberate and act upon.

However, when it comes to details I have a slightly different view. But I guess our small differences in thinking enrich the field. Firstly, I do not regard the concept of conflict as central as you have done in this contribution. I have read papers and met many experts of EE who are trying to convince me that 'conflict' is THE core concept in Environmental Education and in Education for Sustainable Development. I agree that there are often plenty of conflicts when different species live in the same locality. However, in a sense it is trivial when we know that each species changes its environment, and takes space from other species.

I agree that it would be wise to at least test the idea of presenting to students Biodiversity problems that engage deliberation and action in them. I would like to enrich this idea with a concept of wisdom - in particular wisdom as understood in Sternberg's balanced theory of interests. Behind each conflict are different interests, and according to my adaptation of theory of wisdom to Biodiversity Education and Education for Sustainable Development, all the main interests ought to be balanced, if we want to act wisely. I have attached an appendix with a table in which I explain my application of Sternberg's theory of wisdom to problems of Biodiversity and Sustainable Development.

Creating a new framework for Biodiversity Education and Education for Sustainable Development

I have created a new interpretation of Education for Sustainable Development and Biodiversity Education integrating Robert J. Sternberg's (2003) ideas and my earlier work in this field (Table 3). I have developed a new interpretation for culturally sustainable development. From viewpoint of biology everything that is learnt is part of culture, and may be part of cultural evolution, and in this sense may be also part of culturally sustainable development. New components of Sustainable Development are health-centred sustainable development and an amended version of politically sustainable development. Different aspects of sustainable development can be connected with different forms of capital (accumulated work) as presented in the Table 3. All of them ought to be taken care of. At present humankind is not very good at it. There is a huge need for research and development how to best promote integrating learning, thinking and acting to promote sustainable development and all its aspects/components. Education for Sustainable Development and Biodiversity Education need resources to develop. There has been very little systematic research mainly because of lack of research money.

Table 3. How different aspects of sustainable development are related to different forms of Sustainable Development.

Aspect of sustainable development	Form of capital (accumulated work)	Interests which ought to be balanced applying Sternberg's balanced theory of wisdom
1) Ecologically sustainable development	Natural capital, accumulated "work" of Nature, work of ecosystems and resulting free services: cleaning of air, and water, food, raw materials, biodiversity etc.	Nature's interests, interests of life, ecosystems, biodiversity, protection of nature, management of nature
2) Economically sustainable development	Monetary capital, financial capital: Infrastructure, houses, factories, roads, money etc.	Interests of global, regional and local economy, interests of households, interests of quality of life for individual and societies
3) Socially sustainable development	Social capital, social networks, family, friends, humankind, all who share increasing and accumulating win-win thinking and acting	Interests of individuals, families, societies and humankind for good life
4) Culturally sustainable development	Cultural capital, in a new and broader sense: everything worthwhile that individuals, societies, organizations, nations and humankind have learnt during history, including all developing abilities, competence and expertise, intelligence, creativity and wisdom. Cultural capital in this sense includes intellectual capital, creativity capital and a part of human capital.	Cultural interests, interest for education and learning, developing abilities, competence and expertise, intelligence, creativity and wisdom
5) Health-centred sustainable development	"Health capital" is an important part of human capital, which ought to be taken care of. Good health is requirement for all other forms of human capital.	Health interests, interests for obtaining and maintaining optimal level of health individually and socially, nationally and for humankind
6) Politically sustainable development	Trust capital, political capital, e.g: Representatives of nations have signed many agreements to promote sustainable development. They have promised to promote it. If the nations, municipalities, organizations and individuals do not act as they have promised and agreed on, then they lose credibility, their trust capital, political capital.	Political interests, individual and group interests to promote common good as they understand it. Interest for obtaining and maintaining credibility, trust.

Collaborative knowledge-building platform

Horst Freiberg, Federal Agency for Nature Conservation, Germany

A couple of comments and suggestions were actually contributed to the combination of internet-based platforms, the use of digital facilities (cameras) and practical field observations (discovering nature). I agree with Mauri and others that this offers a promising mixture for our purposes to stimulate and facilitate collaborative knowledge building. The question remains: how to do this in practice? Which is the most difficult part. There doesn´t exist "the solution" or "the single truth", rather, there are many solutions and many truths. An R&D project could surely contribute to building such a collaborative knowledge platform – NatureGate might offer a pilot for this? Language should be considered also as possible part of a regional collaborative knowledge building platform.

Mauri also asked for concrete proposals on how to make use of a collaborative knowledge building platform. Let me present one simple (and still sketchy) idea on how to stimulate collaborative knowledge building taken from the comments in this Forum. "A school-based competition activity as part of a regional "collaborative knowledge building platform". There is a web site where you subscribe to and where you can up-load photos. The "web master" posts a photo showing an insect, a tree bud, etc. All subscribers (school/school-teams) should now search in the field the same "master image" take their photo and up load it on the web site. At the end, all subscribers vote on the best "replication" – according the voting, participants (schools) get points which then are listed in a Hall of Fame. Prices could be awarded (key words: EE, competition, voting, interaction, practical field work/observation).

Another activity in this context could be, the "web master" presents a photo (plant) and asks "search this plant and observe how long did it take before the first insect visited the plant – and – take a photo of this first insect visiting the plant. Or - bottom up - one of the Subscribers presents a photo.

In the beginning of the e-conference we also talked about WAP technology. Very recently this message fits well to this item too "TWIG Discovery is the first personal navigation device on the market to combine GSM mobile telephony with GPS navigation capability. It combines the comfort and ease-of-use of in-car GPS voice guidance systems with the familiar, user-friendly and portable format of a mobile phone."

RE: Collaborative knowledge-building platform

Mauri Åhlberg, E-Conference Chair, University of Helsinki, Finland

What you wrote makes sense to me. Your ideas are worth testing in practice, probably as a part of some bigger project. It can be the NatureGate(R) R&D project, or any other similar project which gets enough support, resources etc in order to survive and succeed.

For the future of Biodiversity Learning and Education involvement, I am sometimes a little bit depressed. I am amazed (1) on the small number of people taking part in this Biodiversity Education discussion and its collaborative knowledge

building; (2) on the small number of teachers from schools who are taking part in this discussion and collaborative knowledge building.

We tried our best in Finland and in EU, including the OECD/UNESCO/ENSI network to spread the message of this e-conference.

The future success of Biodiversity Education depends probably not so much on schools, but on general informal education. The theme of this session of e-conference is Youth and Biodiversity. But after reading messages also in the other two session, I have become more and more convinced that learning of all citizens ought to be promoted. It is usually called education, including adult education. Perhaps the most effective way is informal education, using mass media. But in order to be systematic, and have more effect, we also need the cooperation of the formal school system.

Global ESD innovation in progress: NatureGate(R) in Biodiversity Education

Mauri Åhlberg and Leif Schulman, University of Helsinki and Botanic Garden of the Finnish Museum of Natural History, Finland

In the title ESD means Education for Sustainable Development. We understand Biodiversity Education as an important part of wider Education for Sustainable Development, ecologically, economically, and socially sustainable development.

In order to appreciate and protect biodiversity one needs to be able identify and recognize species. Species are the core elements of biological knowledge. All biological knowledge is practically meaningless, if it is not known from which species it has been obtained. Species are also core elements of any ecosystem. In particular plants, as primary producers, are vital to practically all land ecosystems. However, plant blindness, plant neglect is very common in modern knowledge societies.

We are involved in an innovative approach to plant species identification and learning: NatureGate(®. The second author started working in this plant identification project for more than six years ago. From January 2006 the first author joined in, and has developed it into an interdisciplinary R&D project in the CICERO learning researchers' network of University of Helsinki. University of Helsinki has allocated NatureGate® 50 000 euro to start building the first pilot server. NatureGate® has received attention and support from, e.g., The Stanford Center for Innovations in Learning (SCIL) (Stanford University, USA). In Europe, NatureGate® has plenty of R&D cooperation, including Estonia, Hungary, and Sweden. The vision is to create a network of NatureGate® servers in the WWW around the world, in a similar way that Google® has done. We need and seek to cooperate with local biologists, botanists, biology teachers, and educational and learning researchers.

The core of NatureGate® is a library of over 300 000 very professional, accurate, and aesthetically appealing photographs of vascular plants, in particular flowering plants. There are also photographs of ecosystems, habitats, were these plants grow. The NatureGate® R&D project also includes a patented, very fast and user-friendly interactive plant species identification tool. When we get these photos and the identification programme into the WWW, we intend to attach more information. People love flowering plants. When we visit each other's homes we often bring flowers. Top quality photographs of flowering plants will invite people into NatureGate®. Our vision is to link to each of the photograph of a plant species, information about the ecosystem it thrives in. Then we plan to direct users to links and knowledge of the free services of ecosystems to humankind, as established, e.g., in UN's Millennium Ecosystem Assessment (2005). In connection with ecosystems we aim to discuss each plant's and later also other species' roles in sustainable development. We start from flowers, but the owners of the photo library, photographer Jouko Lehmuskallio and his wife Eija, also have plenty of professional level photographs and video clips of fungi, butterflies, and other organisms. Later on these will also be included into NatureGate® servers. Some other professional photographers certainly have photographs of birds etc. These could all be integrated into the NatureGate® servers, if conditions can be approved of and agreed upon.

Summary of research priorities identified in Week 2

Juliette Young, CEH Banchory, UK

Research priorities identified in Week 2 of this session include:

- Gather data on the state of alienation of young people from biodiversity in different parts of Europe and on the links between alienation and educational programmes.

- Develop methods to promote biodiversity education in national school curricula. Scientists have the responsibility to communicate the problem to politicians and policy makers.

- Develop methods to further develop initiatives between scientists and teachers

- Promote the development of interactive tools such as websites with photographs and videos of species and habitats.

- Develop innovations to Biodiversity Education through the increased co-operation between researchers, policy-makers, teachers and NGOs.

- Study and develop the use of new communication technology to connect urban life style of young people with biodiversity protection.

- Develop the use of open-ended problems to engage deliberation and action in students.

- Increased research on how biodiversity can connect to the different problems in society that engage students to act.

Mauri Åhlberg, E-Conference Chair, University of Helsinki, Finland

I have read messages in the other two sessions of the e-conference and have come to conclusion that many of them miss ideas of Biodiversity education, and research on biodiversity learning and education. I take a couple of recent examples:

1. Richard Scott stresses the importance of projects like the Eden project in Cornwall, "which actively seek a broad range of connections and operate in the public realm- direct contact with members of the general public as well as a broad cross sections of science and the media". The point is that it is clearly an educational center, but mostly locally. It has international aspects. I have visited the project and it was a good experience. But when I think of what I use daily to promote Biodiversity Education, it is the worldwide web. We need both (a) local biodiversity research and education centers and (b) collaborative knowledge building, sharing and spreading centers that are using the Internet and the web.

2. Adrienne Ortmann-Ajkai describes in detail a very impressive Hungarian national habitat GIS database, called MÉTA. Then she continues: "We are convinced that education in the broader sense, attitude-forming, is vital to make the public more sensitive to ecological and conservational questions, make them consider these values as important as social and economic ones." Biodiversity education can include much more than promoting positive attitudes towards biodiversity conservation. For me education in the broader sense means every possible means to promote valuable, worthwhile learning. Social scientists used to think that the key is attitudes. Most educational scientists have a much broader view: It is important to develop all human knowledge, understanding, wisdom, of which attitudes are only a small part.

3. Ferdinando Boero wrote an impressive message entitled "Biodiversity witchcraft": "I am not speaking about pandas and dolphins, about rare species and so on. I am speaking, I want to repeat it, about the most important ecological phenomenon of the whole planet both in term of oxygen production and of carbon dioxide consumption, not to speak about the biomass we extract in form of fish (deriving from the primary and secondary production expressed by plankton)." The key message for education is "the most important ecological phenomenon of the whole planet". For sure in education these kinds of claims and messages ought to be discussed. Again both formal and informal Biodiversity Education is needed.

4. Kajetan Perzanowski has a message about Natura 2000 and Red List species: "… it is already difficult for experts to agree on what is the biodiversity we want to preserve. How then are we going to convince people that are not ecology specialists about the urgency and importance of such actions?" From the viewpoint of Biodiversity Education and Education for Sustainable development, the point is not to "convince people", but lead them to inquire, discuss, build knowledge collaboratively about these extremely complex problems about which there is no expert agreement in sight.

5. Paul Opdam makes at least two important points: (1) "The general citizen, entrepreneur and decision maker have no idea why biodiversity would be important to their personal interest. They have no clue why investing in better, bigger or more cohesive structures of ecosystems in their region could be beneficial to the economic future of the region, and to their own quality of life. Biodiversity conservation is getting focused on rare species and habitats, and in this trend we are losing any sense of urgency on the importance of biodiversity. … This calls for a fundamentally

different model of knowledge transfer: from a linear to a network model, in which scientists learn from application and learn how to insert local knowledge into their generic tools." As an educational researcher on biology education and education for sustainable development, I am convinced that interested general citizens ought to be included in collaborative knowledge building for sustainable development, including biodiversity conservation. It cannot continue to be a linear information transfer, which has very little sustainable effect, if any. (2) "The second point urges making links between ecology and social and economic values. It calls … That needs interdisciplinary research. I strongly support Frank Watzold's view on cooperation between ecological, social and economic disciplines here, and would like to add the planning and design discipline." Although he does not explicitly name science of education, educational sciences or educational research, I would like to stress that it is education which in practice promotes Biodiversity learning and education, and it facilitates integration of all multi-disciplinary, interdisciplinary and trans-disciplinary knowledge created. The key is collaborative knowledge building in which experts from different fields with other interested citizens can discuss and create knowledge together.

Asking for research priorities in Biodiversity Education

Mauri Åhlberg, E-Conference Chair, University of Helsinki, Finland

First my four tentative starting points as a list:

- I do not like the name of the session: Youth and biodiversity. When does a human being belong to youth and when is he an adult? Why separate Youth and other ages of learning about, through and for biodiversity? We need lifelong learning of and for biodiversity. It is my starting point for thinking about any research priorities.

- Everybody has to take full responsibility of her/his own learning, thinking and acting, including setting research priorities for biodiversity education.

- We Europeans have a special responsibility for global biodiversity, not only Europe's biodiversity. We have in our continent some of the best collections of plant, fungi and animal specimens, which are needed in order to take care of global biodiversity.

- I do not think of availability of resources when thinking of research priorities. I know that in natural sciences enormous sums are invested in basic and applied research. In educational sciences the research funds have mostly been very small indeed. There ought to be money available also for research on biodiversity education (promoting biodiversity learning) if it is valued enough.

- We need serious, well-funded, long-term cumulative research programmes in order to promote biodiversity education.

In order to stimulate discussion here is my preliminary list of research priorities to promote Biodiversity Education:

(1) In my mind the most important research priority to promote research and fast decisions based on it is how best to create a network of biodiversity servers around the world. I know that there is a server and linked servers called Tree of Life http://tolweb.org/tree/ The first research priority should be: How could the Tree of Life or any other global network of servers be developed into real global network of biodiversity servers promoting biodiversity learning of all humankind? At the time being the Tree of Life server's web pages are often rather old, and the whole is sketchy at best. The number and quality of its photographs is not the best in the world etc. If we understand that life and its diversity are the most important issue we have as humankind, then we ought to address how best to promote learning to conserve biodiversity.

(2) Connected to the global network of biodiversity servers, we need cumulative research on what people learn and think about organisms, biotopes, and ecosystems, and all other aspects of biodiversity. Biodiversity learning and thinking are unobservable processes. We need research on indicators of them. If the global network of servers could allow both scientists and ordinary citizens to send, or upload, photographs, videos, audiotapes, observations and thoughts as text files, and to take part in discussions and collaborative knowledge building, it would allow plenty of research data for both biologists and researchers of biodiversity learning and thinking.

(3) We need research on how people are conserving or promoting biodiversity around the world. What are they thinking, what are they learning when trying to conserve or promote biodiversity? Documents, photographs and videos of these activities could be cumulatively uploaded to the planned global network of biodiversity servers. They would be valuable research data to both biological research and educational research on biodiversity learning and biodiversity education.

(4) We know that digital storage space is becoming cheaper. Internet connections are becoming faster. Mobile technology, GIS, etc are improving. It is a very important research priority of biodiversity education to make research on these issues and in particular how they can be used to promote the global, cumulative network of biodiversity servers for research on biodiversity learning, thinking and action.

RE: Research priorities in Biodiversity Education

Mervi Aineslahti, University of Helsinki, Finland

Mauri was wondering why so few teachers are attending. Yes the conversation between teachers, researchers and the administration is important. Networks such as OECD/ENSI, SEED/Comenius, ENO-online, as well as activities from GLOBE, WWF/Naturewatch (excellent, also in English), local companies (UPM) and other organizations are important.

Biodiversity is not only about knowing species. The connections and the way everything works in nature is important for the children to understand. This can happen by learning about the nature/environment in the nature. To have the emotions and experiences are a crucial part of the learning, this can lead to an effect on attitudes.

The title of our Comenius-project was 'Exploring and interacting with our environment'. We play a lot of environmental games (many of which come from Cornell) when we go out into nature (park, lakes, forest, school yard...). And school children of today want to go out into nature, want to learn about species... and they do learn. I am very optimistic. The atmosphere just has to be 'attractive' and the teacher a behaviour model(Aunt Green). Camp school experiences have shown me this.

Regarding research priorities: To study the circumstances which enable the school to start to build their own innovation, own model. In my experiences it has to be agreed upon by all the teachers. Networks like ENSI/SEED have in our case given us opportunities to build new connections and facilitated the very important type of learning, bench marking and learning from others. So no project, driven from outside, has good opportunities to succeed. But an innovation (I want to use this concept), which is a mixture of many old and new, and integrated and developed together with the whole school community can succeed. I want to pinpoint the role of pupils, their participation. This would be a new area of research, not connected with biodiversity, though.

RE: Research priorities in Biodiversity Education

Irina Herzon, University of Helsinki, Finland

In response to the list of research priorities, just to remind us that a vast number of educational projects are being run by NGOs world over and I am sure they have similarly vast amount of documentation (picture, videos etc) May be it is worth assembling a site with links to (all) such projects (also by governmental organisations, of course) by countries, preferably in several major languages, and promote it among

teachers through national education institutions. Schools should be encouraged in some way in taking part in such extra curriculum activities.

I am also a bit concerned with the focus on technical aspect of learning about nature expressed by several contributors. I do not believe that such innovations (using WWW, GPS etc) will solve a problem of (young) people being ever further distanced from nature. I agree with Per Sjögren-Gulve that one does not even need to know a lot about nature in order to love it and enjoy it, and pass it on to the kids. It is about just getting out there. Internet alone will not necessarily get your kid outdoors. One enthusiastic teacher can be more valuable than dozens of net-portals (see a wonderful message from Mervi Aineslahti, a teacher). What is needed is an array of all the "real world" projects for kids and adults, some excellent examples of which were listed here (seashore, urban waste lands). And, perhaps, better incorporation of conservation issues into teacher-training programmes.

RE: Research priorities in Biodiversity Education

Cornelia Nauen, European Commission, Brussels, Belgium

I would like to suggest staying away from a false dichotomy between either using internet or staying outdoors and enjoying nature without much knowledge about it.

We have changed nature, landscapes, biodiversity on earth over the millennia of our demographic and technological development in profound and comprehensive ways. Most landscapes today are cultural landscapes showing signs of our impacts.

Yet, 'naive' ways of enjoying nature, reproducing perhaps the collectors' reflexes on the beach or the mountains without much thinking, especially in conjunction with phenomena such as modern mass tourism, are not innocent at all and can even be quite destructive.

Well organised information resources which are relatively easy to consult in combination with outdoor activities and re-connecting in multiple ways to nature may even be indispensible to reach the many millions of people - not only a small elite - to make a real difference. Why not seek ways to combine what is best from a range of approaches - but always putting lots of emphasis on overall increase of information, understanding and knowledge (as a social form of appropriating information).

Why not appeal to the natural classification drive of children well before they get into puberty by giving them access to animal and plant classification (rather than pokemons - though the success of the comics illustrates that anything appealing to that need will be effortlessly absorbed).

Why not combine a good scientific foundation with the arts, which cover a different, complementary spectrum of ways of knowing, human emotions and development. That might address the concern over exaggerated emphasis on technicalities or even technocracy?

Finally, supporting teachers through social recognition, better internet resources and material conditions is indeed a cornerstone in forming the value system of the next generations. After all, we entrust them with a pivotal role in the lives of our children. Are there any concrete mechanisms targeted to achieve this, or is it a wish list at this stage?

RE: Research priorities in Biodiversity Education

Horst Freiberg, Federal Agency for Nature Conservation, Germany

There are surely many approaches to stimulate youth and adults to become interested in biodiversity. From our modern way of life in Europe (this will differ in Developing countries), the Internet is a main back-bone for any work related to biodiversity "education" - it complements the traditional media used so far. It is true that there exists more flexibility in Ground schools (age 6-10) for field works and excursions into nature. Teachers are the moderators for their pupils - and parents too. Parents are more dedicated to contribute to any out/in-door activity during this time than later - one exception of course is the kindergarten. This could offer an opportunity to "incorporate" children and parents, grandparents, family and business into "sustainable" activities related to biodiversity. Bridging the gap between youth - parents - grandparents - family and business would be perfectly possible. This could be one research area - how to stimulate this type of "educational chain" - as a mixture between practical field work/observations and Internet stimulating collaborative knowledge building and the exchange of experiences etc.

In higher level school classes (5-10) it becomes difficult to organize a special biodiversity day for practical nature observations or field work - this is mostly done in the frame of an appointed "school week". At least it should be reflected for classes of grade 5-7 to have one field day per month for nature/biodiversity related activities (also to make use of the many internet-based participatory projects and platforms in order to build collaborative knowledge over longer time than only once a time).

RE: Research priorities in Biodiversity Education

Karin Ulbrich UFZ-Centre for Environmental Research Leipzig-Halle, Germany

I agree with Horst Freiberg that for higher level school classes it is more difficult to organize field work and nature observations than for younger children. However, there is a good tradition in some schools (e.g. in Saxony-Anhalt, Germany) with scientific work: In the course of grades 10, 11 or 12 students carry out facultative scientific work which is supervised by scientists from university or research institutes. About 60% of the students of these schools participate as the acceptance is quite high. I suggest that we have good chances of stimulating pupils to deal with biodiversity topics announcing them via the Internet, schools or other channels. According to my experience, public centres for environmental education are appropriate and willing partners in supporting these studies. Altogether, we should inspire schools to form a "bridge" by encouraging students to perform facultative scientific work .

Comments on research priorities in Biodiversity Education

Mauri Åhlberg, E-Conference Chair, University of Helsinki, Finland

(1) I agree on many of the points in Per-Olof's and Iann's answer to my message., e.g: "We believe that the main message and empirical result of our study is that issues on biodiversity are not just problems about biodiversity." I think biodiversity ought to be dealt as a part of sustainable development. Biodiversity Education can be part of both Environmental Education (EE) and Education for Sustainable Development (ESD). I personally prefer the broader one: ESD. We probably share the view that conflict of interest has its place in useful concepts in both EE and ESD. I personally avoid conflicts, and conflicts of interest as much as I can. Since 1992, I have developed a theory of win-win solutions and win-win strategies for ESD, and continually test it, both theoretically and empirically. Actually, in practice Per-Olof, Iann, and my research group have found many win-win strategies and solutions, and very little of conflict of interests. However, in EE and in biodiversity Education we slightly different views. A win-win solution is to regard these differences in views as enrichments of our thinking, as possibilities to test, and elaborate our views and theories. We all need critical friends in order to develop in our thinking, feeling and acting.

(2) We may have slightly different views on underpinnings of conflicts of interests in biodiversity. Per-Olof wrote: "The conflicts of interest in biodiversity are not a matter of conflicts between species and what we think of the rights of different species." I think that only human beings can defend other species or biodiversity. The point to me is we have to identify and to recognise species, in order to understand their value. Carabid experts (Carabidae) for instance have found small carabids living inside sea water in a bay near Helsinki. The species is known only in a couple of places in the whole world. The carabids cannot protect their rights, it must be human experts who do so. In that sense you may say that it is always conflict of human interests. Wisdom, as understood balanced integration of many different interests, is probably needed here.

(3) I fully agree in what Irina Herzon wrote: "Internet alone will not necessarily get your kid outdoors. One enthusiastic teacher can be more valuable than dozens of net-portals (see a wonderful message from Mervi Aineslahti, a teacher). What is needed is an array of all the "real world" projects for kids and adults, some excellent examples of which were listed here (seashore, urban waste lands). And, perhaps, better incorporation of conservation issues into teacher-training programmes." - I am a teacher educator myself. As a Professor of Biology Education, I am teaching biology education and research on biology education to both classroom teachers and subject teachers, and to my doctoral students. We have very little time in courses to deal conservation issues. That is why, I prefer digital services in the Internet. But they ought to be of excellent quality, on order to promote lifelong biodiversity education. Ms. Mervi Aineslahti, classroom teacher, is one of my doctoral students. Since 2002, she has taken part in our digital collaborative knowledge building in Knowledge Forum® platform to promote Education for Sustainable Development. She has used also Internet with her pupils, and, as far as I have learnt to know her, she would use also mobile digital tools and Internet servers if they were available in her school.

(4) I fully agree on Dr. Cornelia Nauen's message, e.g.: "Well organised information resources which are relatively easy to consult in combination with

outdoor activities and re-connecting in multiple ways to nature may even be indispensable to reach the many millions of people - not only a small elite - to make a real difference. Why not seek ways to combine what is best from a range of approaches - but always putting lots of emphasis on overall increase of information, understanding and knowledge (as a social form of appropriating information)." I find it balanced, integrating and wise. We need to integrate the best of many useful and practical approaches. Currently, we do not have any excellent broad servers in practice, but in my research group have a vision, a plan, and a strategy for global network of servers, the working name of which is NatureGate®. Biodiversity issues are part of living nature, But in ecosystems there are always also abiotic parts, that is why we need also knowledge and understanding, and digital materials of non-living nature.

RE: Comments on research priorities in Biodiversity Education

Iann Lundegård and Per-Olof Wickman, Stockholm Institute of Education, Sweden

Thank you for your comments Mauri. We fully agree that conflicts of interest cannot stand on their own to explain the complexities of issues concerning environmental education or on education for sustainable development. However, we feel that this is not just a question of taste of where to start the discussion most productively. We think that we should support our standpoints on empirical evidence and not just theoretical models or ideas. However, all the evidence suggests that it is on conflicts about values that most people start the discussion, and this very discussion may be seen as an example of this.

We believe that the main message and empirical result of our study is that issues on biodiversity are not just problems about biodiversity. The conflicts of interest in biodiversity are not a matter of conflicts between species and what we think of the rights of different species. Rather they are conflicts between human interests that engage people (these interests may of course primarily concern biodiversity, but not necessarily, a priori). In our interviews we did not ask the students specifically about biodiversity but about the environment generally. So I will give you an invented example to explain the point.

To produce interest in biodiversity many people have argued that biodiversity problems become more interesting to people if they can gain something else from protecting biodiversity, e.g. ecotourism has been a way to produce interest in biodiversity locally. This is because we cannot expect everybody to start their concern for biodiversity in biodiversity per se. This is the kind of connections we are talking about, and we need to find more such connections were human interests seem to collide, but where deliberation can help us find possibilities and solutions. It is important to see the interests that the young generation has and see how they conflict with other interests and try to find solutions, so that they stop being a problem to both parties.

Citizen science and community participation in protected area management: a model from Rodna Mountains National Park, Romania

Anna Lawrence and Alina Szabo, Oxford University, UK

Summary: There has been a strong recent focus on 'citizen science' and the benefits of including volunteers in monitoring biodiversity. In particular, there is a need for new models of participatory conservation appropriate to the conditions of Central and Eastern Europe. We are testing a simple but relevant model for community participation in protected areas in the northern Carpathians of Romania through involving local schools in park management activities.

There has been a historical tendency to exclude citizens and their knowledge from conservation decision-making processes. Information, if provided at all, was provided in one direction only – from the authorities to the public.

Over the last two decades, conservation ideas have developed in three significant ways:
- From a focus on species to a focus on ecosystems and processes
- From blueprint management to adaptive management
- From centralised, hierarchical planning to participatory approaches, which recognise the value of local knowledge, local commitment to place, and traditional customs and rules for protecting resources.

There has also been a strong recent focus on 'citizen science' and the benefits of including volunteers in monitoring biodiversity.

The benefits of participation are not simply that it provides scientists and policy makers with free data, or that it teaches scientific values to members of the public. Conservation is enriched through the wealth of local knowledge, and governance is strengthened as citizens engage with decision-making.

To move beyond generalisations, and develop models appropriate to the conditions and realities of stakeholders in each place, there has been a move to focus on the issues at national and local level. Participatory approaches can be helpful in this context, but existing models rely either on a strong civil society sector, as in western Europe, or coherent semi-autonomous communities motivated by resource dependence to respect traditional rules, as in developing countries.

There is a need for new models of participatory conservation appropriate to the conditions of Central and Eastern Europe. A more inclusive and less alienating approach to park management is also likely to be more effective through engaging the support of a greater part of the community.

We are testing a simple but relevant model for community participation in protected areas in the northern Carpathians of Romania as part of a Darwin Initiative funded project. The approach recognises that participation is a relatively new concept for many of the stakeholders, and therefore builds on existing relationships of trust within communities and schools, as well as joint learning activities.

This approach includes the following key features.
1. School children are involved in documenting local and traditional knowledge and use of the national park, thereby learning from their grandparents and neighbours, and raising the profile of the park with these same people.
2. Schoolteachers were consulted through a special advisory group, during the preparation of the recent management plan.
3. In eight communities around the Park, schools have formed 'Friends of Rodna Mountains' clubs. Each club consists of children of a particular age and community,

and focuses on the specific interests of their school. For example, one club is from an art school, and uses art as an approach to understanding and promoting the park.

4. Each club contributes directly to the implementation of the management plan, by selecting a specific group of plants or animals to study. The club collects and provides data to the park management team, to contribute to baseline, monitoring and management decisions.

5. Together with the park staff, each club organises excursions to the park, which are extremely popular with the students. For many this is their first contact with the park and they are now associating biodiversity and conservation with a positive experience instead of something restrictive.

6. Data collection by students acquires scientific reliability and status through collaboration with local scientists and training in GIS (geographical information systems). This also allows the park administration to consolidate and map all the data.

7. Very importantly, the clubs share their experiences and data. They link up with the other clubs, to exchange experience and news at workshops and camps. And they meet with the national park administration to learn how they have contributed to park management.

The park administration team not only uses the data collected by the students, but accompanies the students, provides training in data collection methods, and communicates to the students and the club coordinators the ways in which the data has been used. The approach is promising: already the clubs are discussing ways to ensure they can continue beyond the three-year project period, and have decided to set up a non-profit organisation to provide a formal framework for their activities.

RE: Citizen science and community participation

Agnes Mero, St Istvan University, Godollo, Hungary

I would like to share with you some of our experience we had in two of our agro-biodiversity protection related action research projects of local scale, done in a participatory manner.

Reading the articles I was thinking about big campaigns on endangered species, nature channels on TV and thought that all these give a supply of information about threats to biodiversity, but do people know how they could do something about them? One of the projects I would like to introduce you to was about saving landrace fruit species via making a map and a list of old trees. The work was to be done by local primary school children and it was helped by teachers, university students, national park rangers and local farmers. The other project was on local bean varieties also in danger of disappearing for ever. It was a two days long bean festival organised by our research group and local people together. It was raising public awareness on the importance of crop genetic diversity, cultural knowledge combined to local varieties and the ways to preserve them.

Both projects emerged from other research projects where it was found out, that core problems in natural resource management was lying in society (older generation caring for orchards or small scale gardens are dying and younger people do not find agriculture important or find it too much troublesome.) Our aim was to provide information for the young via intergenerational relationships and scientific actors in a playful manner, so that they become pride of their cultural heritage and preserve them. For further information please contact us at www.essrg.org

Reading Nature- Linking biodiversity and ecosystem function in an educational context

Ola Magntorn, Kristianstad University

The significance of the activities of Earth's biota is well established but we have only recently started to look at the significance of Earth's biodiversity. For example we have a well-developed understanding of photosynthetic activity on a sub-cellular scale as well as a well-developed understanding of primary production on global scale but we have by comparison, little understanding of how plant diversity in a grassy meadow or a forest affects production at the ecosystem or at the global scale (Loreau et al. 2002). It was not until the early 1990s that the interests for ecosystem function and biodiversity merged (Golley 1993; Sandell et al. 2003). In the last decade the number of papers including biodiversity in the title or in the abstract has increased from a few hundred annually to nearly four thousand (Loreau et al. 2002). I believe it is of great importance to take another important step forward by linking educational research to the growing field of biodiversity and ecosystem function research.

In my research on ecological understanding I follow students' ability to Read nature (Magntorn & Helldén, 2005). The phrase "reading nature" focuses on ecology and the context is outdoors. Reading nature has to do with an ability to recognise organisms and relate them to material cycling and energy flow in the specific habitat which is to be read. It has to do with the natural world that we face outside and the tools we have are our experiences from previous learning situations both in and out-of-doors. It also has to do with understanding the relationships between functional groups and how abiotic factors, such as light and speed of water influence the whole ecosystem. In one of my studies I followed students' developing ability to give a relevant interpretation of the river as an ecosystem based on recognition of a common key stone species and its autecology- the freshwater shrimp.

If we turn back to biodiversity research, there are at least three ways in which the idea of function enters in the biodiversity and ecosystem function debate (Vandermeer et al. 2002; Diaz et al. 2003; Jax 2005) First we have the effect of biodiversity on ecosystem function where changes in biodiversity can cause changes in ecosystem characteristics such as productivity or nutrient cycling. Second, we have the biodiversity as a function of the ecosystem where the abiotic conditions determine the biodiversity. In a third aspect the ecosystem is seen as having a larger "function" (e.g. provision of high quality water or carbon sequestration). Most ecological research has been related to the first category where the area of investigation and the number of species normally are relatively small. There is a strong demand on the field of research to look at whole ecosystems if we are to predict changes in ecosystem function due to global changes of our ecosystems (e.g. Bengtsson 1998, Walker 1999, Petchey et al. 2002).

Bengtsson writes critically that there has been too much discussion on species richness and ecosystem function. His critique is basically that it has been considered that focusing on species number indicates that all species are potentially equal with respect to function. Is one earthworm equal to 1, 10 or 100 mites or fungi?? Unless we know more about what the species really do in the ecosystem these exercises are of little value (Bengtsson (2002). Determining the functional groups and relating them to whole systems leads to different outcomes depending on which ecosystem you look at and therefore it is difficult to find a standard research form for this (Naeem & Wright 2003). I believe that educational research in relation to biodiversity should try to find

other approaches than quantifying diversity by counting species. Identification of key stone species or key processes can be an important way forward. Folke et al (1996) writes that a limited number of species or groups of organisms seem to control the critical processes necessary for ecosystem functioning. They termed these species "key stone process species" Among those species are the "ecosystem engineers" (Jones & Lawton 1995), classical keystone species such as earthworms acting as interactive control (Chapin et al. 1996) or those which are involved in trophic cascades (e.g. the interactions in lakes where certain fish species indirectly affect plant diversity (Knight et al. 2005). Developing teaching models where students identify keystone process species in the ecosystem, recognised by the biodiversity researchers, and building an understanding of the functioning based on these few but important organisms can be an important link between the biodiversity-functional research and educational research.

'The Stack' helps biology students in their 'biodiversity crises'

Viivi Virtanen and Jouno Rikkinen, Department of Biological and Environmental Sciences, University of Helsinki, Finland

'The Stack' is an e-learning environment that promotes basic and advanced skills in species identification – its primary objective is to improve the quality of biodiversity training of university students in biology. The name 'Stack' refers to the heaps of dry herbarium specimens that pile up on students desks during traditional plant identification courses.

The Stack is based on a systematically arranged, easily accessible database containing species photographs and descriptive text. Each organism is illustrated by numerous high-resolution colour photographs, which display its general habit and the details essential for correct species identification. The database and all teaching modules will be available in Finnish, Swedish, and English. In addition, the scientific names will be linked to audio files containing the correct pronunciation in classical Latin. All scientific terms will be described in an extensive vocabulary.

Computer supported learning makes biodiversity studies flexible: students can choose the most appropriate time and place for their studies. They can search the database, pick virtual specimens and construct personal herbaria. These virtual collections can be easily modified and returned to at a latter date. Students can also exchange virtual specimens and experiences via a discussion forum. Naturally, the use of any e-learning environment requires a certain level of independence and self-regulation – here feedback and tutorial help are essential. The Stack motivates biodiversity teachers to improve their teaching – it provides a very attractive platform and basic tools for high quality teaching.

In the future, the Stack can be used as a resource and tool in many types of web-based biology courses. Obviously it can be easily complemented with other web-resources and -tools. Via the Internet, topics related to biodiversity and nature conservation can also be introduced to the general public – eventually the Stack aims to encompass the entire educational chain from secondary schools to universities and all types of users from the general public to professionals in various fields of biology and environmental sciences. Thus, the Stack can play an important role in reinvigorating the entire field of descriptive taxonomy.

Voluntary sector

Richard Harrington, Rothamsted Research, UK

There has been much useful discussion on the involvement of schools in biodiversity education. Of course that is the route to most children.

However, it is also worthwhile remembering the voluntary sector. The Scout Association, for example, has 18 million members worldwide (in all but six countries) and a training programme that is very receptive to biodiversity and conservation issues. Good resources are lapped up by leaders. A recent link-up resulted in many Scouts getting involved in the Woodland Trust's `Nature Detectives' programme, through which they contribute records to the UK Phenology Network, which is doing much to help understand the impacts of climatic changes on `nature's calendar'.

Biodiversity education and ENSI-Project

Lea Houtsonen, The Finnish National Board of Education

The development of biodiversity education can utilise the work done in the international ENSI-project (Environment and School Initiatives): www.ensi.org/

In line with Peter Posch (2006), the ENSI-project perceives that students should be involved with environmental issues at the following three levels:
1) Personal experience and emotional commitment
2) Inter-disciplinary learning and research
3) Socially important actions

The ENSI-project consists of a voluntary cooperative group of members from 30 OECD countries (Europe, Asia-Pacific and North-America), and the project has established a partnership with UNESCO. The idea behind the ENSI-project is based on two conflicting concepts, economy and environment, and the solution is perceived to be Environmental Education. The overall aims and objectives of the network are (Pfaffenwimmer 2006):
-To promote and facilitate sustainable thinking and acting within the educational system;
-To create stable learning networks which link schools, families, communities and workplaces together;
-To foster the democratic participation of students as active citizens in shaping the environmental conditions of their life and work.

So far the ENSI-project has facilitated collaboration between pupils, teachers, research institutions and other organisations, and promoted activities relating to sustainable development in schools and communities.

One of the objectives of future actions of the ENSI-project is to develop pedagogical methods which can help to strengthen the cooperation between educational institutions (schools), local administration and researchers on a local level by making use of the new information technology. One opportunity is to utilise the geographic information systems, GIS. Research has largely been concentrated on making use of GIS for scientific purposes and in various social spheres, and less emphasis has been placed on GIS research and development in the field of education. It would, indeed, be important to study which pedagogical methods could best be applied to the teaching of GIS in schools. Biodiversity education offers excellent opportunities for this kind of development work.

Co-operation between different school forms

Susanna Tauriainen, Finnish National Board of Education

I would like to emphasize that one of the most important way to promote biodiversity is to create better co-operation between different school forms. For example better exploitation of vocational education and training, especially agricultural institutes and their school farms and fields could offer a good educational environment to demonstrate promotion of biodiversity in reality. The promotion of biodiversity is one of the most important goals in the school farms today, because their must take into account it according to legislation in any case.

In Finland we are creating a new and an innovative common platform to learn in the form of virtual village (unfortunately only in Finnish). This could be a place of worldwide demonstration to promote biodiversity in practise as a form of examples. Here is the link to the virtual village: www.virtuaali.info/

A UN decade of biodiversity 2011-2020

Horst Freiberg, Federal Agency for Nature Conservation, Germany

This may be a strange point – but this Forum may offer a place for it. From the many contributions (including those in the session on "How to reach the 2010 - and beyond target") I extract my proposal that through the EPBRS policy decision makers should be invited to reflect and hopefully agree on a "UN Decade of Biodiversity 2011-2020" which could fostering the need for focused biodiversity research stimulating international research cooperation, know-how transfer and partnership building. The arguments behind this have been presented during the e-conference itself. The countdown to 2010 is progressing- but what happens after it? The EU communication implies with the wording "...and beyond" yet that something has to happen after 2010. CBD COP 8 agreed to invite UNGASS to declare the year 2010 the International Year of Biodiversity. Kofi Annan assigned at the 61st UNGASS a higher priority to this by proposing a new target under MDG 7 with "to significantly reduce the rate of loss of biodiversity by 2010". We have raised a lot of awareness with this e-conference - which we hope will influence policy makers to continue regarding biodiversity a top priority in their political work. Up to 2010 we can be sure that this will be so - but what happens after this? We suppose and expect to have reached by then a high and visible level of recognition of the importance of biodiversity - but much remains to be done. To maintain this high level of awareness and the need for continued political dedication a "UN Decade of Biodiversity" starting after the International UN Year of Biodiversity 2010 extending from 2011-2020 could possibly maintain this visibility on all levels.

Final week summary

Juliette Young, CEH Banchory, UK

Research priorities identified in this last week of the e-conference include:

Biodiversity education in schools:
- Develop teaching methods focussing on interactions and processes.
- Develop teaching models where students identify keystone process species in the ecosystem, and build an understanding of the functioning based on these few but important organisms
- Develop better incorporation of conservation issues into teacher-training programmes.
- Promote methods to foster the cooperation of the formal school system in biodiversity education.
- Study the circumstances that enable innovations in schools, particularly the role and participation of pupils in developing new models.
- Research to determine which pedagogical methods could best be applied to the teaching of GIS in schools.
- Provide more support to teachers through social recognition, better internet resources and material conditions

Informal biodiversity education:
- Promote general informal biodiversity education through, for example, new virtual media (NAJU project) or the voluntary sector (the Scout Association)
- Develop lifelong learning mechanisms
- Explore the potential for biodiversity education of involving school children in biodiversity management
- Develop methods to promote communication through intergenerational relationships and scientific actors in order to foster conservation.
- Promote biodiversity education through the integration of well-organised information resources with outdoor activities and re-connecting in multiple ways to nature
- Develop ways to encourage the "educational chain" between children, parents, family and business through practical field work/observations, collaborative knowledge building and the exchange of experiences.

Biodiversity education resources:
- Develop major, well-funded, long-term cumulative research programmes in order to promote biodiversity education.
- Promote the development of a of global network of biodiversity servers around the world building on existing networks
- Produce indicators of biodiversity learning, thinking and action
- Promote research on the potential of new media in biodiversity learning, thinking and action.
- Research on the identification of connections were human interests seem to collide, but where deliberation can help us find possibilities and solutions.
- Foster the concept of a "UN Decade of Biodiversity" to maintain momentum of biodiversity conservation beyond the 2010 target.

Many thanks to all contributors to this session for your insightful contributions. All the research priorities identified in this session will be compiled and will form the basis for the EPBRS meeting in Helsinki in November.

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