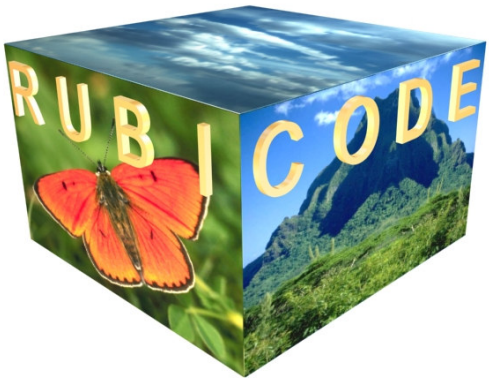

The **RUBICODE** Project

Rationalising Biodiversity Conservation in Dynamic Ecosystems

Funded under the European Commission Sixth Framework Programme (Contract Number: 036890)

THE WAY AHEAD IN ECOSYSTEM SERVICE & BIODIVERSITY RESEARCH

Workshop on

Ecosystem Services and Biodiversity Conservation:

Knowledge gaps and roadmap for future research

Leipzig, Germany, 12-14 January 2009

WORKSHOP REPORT

Workshop report summary

Workshop objectives

The aim of the final RUBICODE workshop "*Ecosystem Services and Biodiversity Conservation: Knowledge gaps and roadmap for future research*" was to identify research priorities for the RUBICODE research roadmap. Its specific objectives were:

- To assess the state-of-the-art of research on ecosystem services and biodiversity, including progress in the RUBICODE project.
- To consider how ecosystem services can be incorporated in conservation policy.
- To consider the current state of research policy related to ecosystem services and biodiversity conservation.
- To identify gaps in knowledge and research needs.
- To identify innovative approaches for transferring research knowledge into policy.

Breakout groups identified the following priority research areas.

Research priorities on ecosystem services and drivers of change

- Integrated assessment methodology for investigating interactions between the demand and supply of multiple ecosystem services across different scales.
- Investigation of tipping points beyond which ecosystem service delivery changes dramatically and perhaps irreversibly by quantifying the relationships between biodiversity, ecosystem functioning, ecosystem services and human well-being.
- Tools for designing and evaluating policy options for ecosystem service management under uncertain futures.
- Impacts of human perception and behaviour on the maintenance of biodiversity and ecosystem services.
- Business opportunities associated with the sustainable management of ecosystem service delivery.

Research priorities on quantification and valuation of ecosystem services

- Develop an improved classification for ecosystem services and values, including better understanding of distinctions between final and intermediate services, and between values of flows of ecosystem services and stocks of ecosystem assets.
- Improve understanding of the role of the cultural, economic and policy contexts in the choice of: (i) metrics, valuation and appraisal methods; (ii) stakeholder involvement; (iii) required levels of precision; and (iv) policy instruments and decision support tools.
- Enhance the usefulness of value, price and cost estimates by: (i) improving database coverage, quality, depth and access; (ii) filling key gaps in valuation evidence; (iii) studies to investigate replication, validity and transfer of functional assumptions and values estimates; and (iv) developing agreed protocols for comparing and transferring value estimates.
- Improve methods for taking account of, and communicating, dynamic aspects, including: (i) risk/uncertainty in service provision; (ii) ecological thresholds, tipping points and irreversibility; (iii) evolutionary change of the system under valuation; and (iv) changes in economic systems, preferences and technologies.
- Improve methods for the valuation of services at different scales, including methods for: (i) upscaling and downscaling; (ii) incorporating integrated assessment (long term and global) in valuation methods; and (iii) integrating valuation processes and results in impact assessments (EIA, SEA, SIA, etc) and IA models.

Research priorities on indicators and traits-based approaches for ecosystem service assessment

- Improve knowledge of trait-based multitrophic linkages within ecosystems by improving knowledge of traits underlying ecosystem service provision (traits lists, databases and protocols).
- Quantify changes in ecosystem service provision as a result of environmental pressures.
- Develop trait-based approaches, including traits-based thresholds (SPUs), to define quantitatively what constitutes adequate service provision.
- Identify where trait-based indicators can fill existing gaps in indication of ecosystem service provision by transferring traits into tangible, communicable and relevant indicators to address the target audience (indices, multimetrics, etc).
- Scale up trait-based indicator approaches to broader scales by establishing and validating links between on-site data and remote sensing data.

Research priorities on habitat management and conservation policy

- Multi-level governance of ecosystem services – understanding drivers and levers.
- Tools, methods and decision-support systems for ecosystem service assessment integrated into a multifunctional toolkit.
- Multifunctional landscapes and ecosystem integrity.
- Recognition of the role of small invertebrates, lower plants and fungi in ecosystem function and service provision.
- Linking landscape pattern and processes (ecosystem services) with land management.

Contents

1. Introduction

The final RUBICODE workshop took place in Leipzig Germany from 12 to 14 January 2009. It involved 38 stakeholders from policy-making institutions, civil society, and business from across Europe, and 23 RUBICODE researchers (see Annexes).

The aim of the workshop was to identify research priorities for the RUBICODE research roadmap. Specifically, the workshop objectives were:

- To assess the state-of-the-art of research on ecosystem services and biodiversity, including progress in the RUBICODE project.
- To consider how ecosystem services can be incorporated in conservation policy.
- To consider the current state of research policy related to ecosystem services and biodiversity conservation.
- To identify gaps in knowledge and research needs.
- To identify innovative approaches for transferring research knowledge into policy.

A background paper was circulated before the workshop. It included research priorities from the RUBICODE project's reports (http://www.rubicode.net/rubicode/outputs.html):

- Review on concepts of dynamic ecosystems and their services (Vandewalle et al. 2008)
- Review on the dynamics of economic values and preferences for ecosystem goods and services (Kontogianni et al. 2008)
- Identifying and assessing socio-economic and environmental drivers that affect ecosystems and their services (Anastasopoulou et al. 2007)
- Assessing and monitoring ecosystems: Indicators, concepts and their linkage to biodiversity and ecosystem services (Feld et al. 2007)
- Review of indicators targeting habitat area (da Silva et al. 2007)
- Functional traits underlie the delivery of ecosystem services in different trophic levels (de Bello et al. 2008)
- European habitat management strategies for conservation: Current regulations and practices with reference to dynamic ecosystems and ecosystem service provision (Haslett et al. 2007)
- The effectiveness and appropriateness of existing conservation policies and their integration into other policy sectors (Jongman et al. 2008)

The background paper also included recommendations from the four RUBICODE workshops, the RUBICODE e-conference on "*Ecosystem services and drivers of biodiversity change*", output from previous and ongoing European and national biodiversity research strategies, initiatives and projects, including DIVERSITAS (http://www.diversitas-international.org), Biodiversa (http://www.eurobiodiversa.org/) and EPBRS (The European Platform for Biodiversity Research Strategy, http://www.epbrs.org), the EU-framework projects ALARM (Assessing Large Scale Risks for Biodiversity with tested Methods, http://www.alarmproject.net) and ALTER-Net (A Long-Term Biodiversity, Ecosystem and Awareness Research Network, http://www.alternet.info).

2. Workshop programme

This report focuses on the outputs from breakout groups (Section 3). In addition, and partly in preparation for these breakout sessions, the workshop programme included the following presentations and panel discussions:

Introductions	
Introduction to the workshop	Steven Libbrecht, Prospex, Belgium
Introduction to RUBICODE	Allan Watt, CEH, UK
Research on ecosystem services and biodiversity?	
The Ecosystem Service concept: high hopes but low expectations?	Carsten Dorman, UFZ, Germany
Ecological engineering: how can ecosystem services be incorporated into biodiversity conservation and agricultural policy	KL Heong, IRRI, Philippines
The Multiscale Integrated Model of Ecosystem Services (MIMES), a modelling collaborative on estimating the dynamics and distributions of Ecosystem Function Values	Roelof Boumans, Gund Institute for Ecological Economics, University of Vermont, USA
Highlights from RUBICODE's research	Paula Harrison, Oxford University, UK
Ecosystem services and conservation policy?	
Panel and plenary discussion: how can ecosystem services be incorporated into conservation policy? Panel members: Karin Zaunberger, DG Environment, European Commission; Marion Calvini, DEFRA, UK; Horst Korn, Federal Agency of Nature Conservation, Germany; Pam Berry, RUBICODE	
Research policy, ecosystem services and biodiversity conservation	
EU Research Policy	Astrid Kaemena, DG Research, European Commission, Belgium
Research Policy	Carsten Nesshöver, EPBRS and UFZ, Germany
Transferring research knowledge into policy: innovative approaches	
Knowledge transfer: 9 reasons why we (still) fail	Rainer Müssner, Federal Ministry of Education and Research, Germany
Knowledge transfer: The business experience	Bernd Wilke, Swiss Re, Switzerland
Knowledge transfer: The US experience	Bruce Jones, US Geological Survey, USA
Panel discussion on implications for research policy followed by open plenary discussion. Panel members: Astrid Kaemena, DG Research, European Commission; Karin Zaunberger, DG Environment, European Commission; Allan Watt, RUBICODE	

3. Gaps in knowledge and research needs

Four breakout groups considered gaps in knowledge and research needs in the following areas:

- Breakout Group A: Ecosystem services and drivers of change
- Breakout Group B: Quantification and valuation of ecosystem services
- Breakout Group C: Indicators and trait-based approaches for ecosystem service assessment
- Breakout Group D: Habitat management and conservation policy

3.1 Ecosystem services and drivers of change

Top five research priorities

A. Integrated assessment methodology for investigating interactions between the demand and supply of multiple ecosystem services across different scales.

- *Why is it important?* Ecosystem service assessment requires a multi-disciplinary approach. Demand from ecosystem service beneficiaries and the supply of services by biodiversity operate and interact at different scales.
- *How can it be addressed?* Integrated assessment modelling involving physical/ecological and socio-economic approaches. Scaleable models covering local, regional and continental scales. Assessment of synergies (positive feedbacks) and conflicts between different services and different ecosystems.

B. Investigation of tipping points beyond which ecosystem service delivery changes dramatically and perhaps irreversibly by quantifying the relationships between biodiversity, ecosystem functioning, ecosystem services and human well-being.

- *Why is it important?* Need to understand sensitivity and dynamics of ecosystems to environmental change. Increase understanding of how ecosystem services are provided (CBD in terms of biodiversity, so need to be able to relate biodiversity to ecosystem service provision; also needed to know how best to manage services through managing underpinning biodiversity). Link between ecosystem services and human well-being is poorly understood.
- *How can it be addressed?* Analysis of non-linear dynamics, thresholds and tipping points (positive feedbacks for enhancing services in addition to tipping points indicating service collapse). Effects of ecosystem service disruption on society. Identify and quantify the components of biodiversity required for service delivery, e.g. service providing unit (SPU) approach.

C. Tools for designing and evaluating policy options for ecosystem service management under uncertain futures.

- *Why is it important?* Need policy tools to deal with uncertainty and frameworks to explore trade-offs.

- *How can it be addressed?* Participatory scenario development, probabilistic approaches to uncertainty assessment, frameworks for assessing multiple ecosystem services, methods for enabling decision-making based on incomplete knowledge, where does uncertainty occur and can it be narrowed, responses to extremes and shock events.

D. Impacts of human perception and behaviour on the maintenance of biodiversity and ecosystem services.

- *Why is it important?* There is still a major gap in the social science contribution to ecosystem service assessment, but it is critical to understand human perceptions of ecosystem services and how human behaviour changes demand for ecosystem services.

- *How can it be addressed?* Agent-based modelling, other social science methods.

E. Business opportunities associated with the sustainable management of ecosystem service delivery.

- *Why is it important?* Stakeholder driven (businesses are beginning to take an active interest in ecosystem services and are asking for this information). They are also likely to have a big impact, therefore, it is critical to engage this community. Communication and awareness raising.

- *How can it be addressed?* Tools/methods to help businesses address and manage ecosystem services, e.g. stakeholder engagement processes (identification, role, integration of their views – MCA), trade-offs between different management options, incentives/mechanisms for ecosystem service management, exploration of externalities (full cost accounting), Life Cycle Analysis, case studies.

3.2 Quantification and valuation of ecosystem services

Top five research priorities

A. Develop an improved classification for ecosystem services and values, including better understanding of distinctions between final and intermediate services, and between values of flows of ecosystem services and stocks of ecosystem assets.

- *Why is it important?* Clear classification is essential for avoiding problems of double-counting and under-counting, both because services are nested, and because users of valuation studies need to know what is, and is not, included.

- *How can it be addressed?* Further work on appropriate classification schemes and accounting frameworks at different scales and for different purposes. Improved reporting practices in valuation publications.

B. Improve understanding of the role of the cultural, economic and policy contexts in the choice of: (i) metrics, valuation and appraisal methods; (ii) stakeholder involvement; (iii) required levels of precision; and (iv) policy instruments and decision support tools.

- *Why is it important?* Methodologies can influence outcomes, and the most appropriate choices will vary with cultural, social, economic and policy factors. For practical applications, effort must be proportionate to the policy context.

- *How can it be addressed?* Continued work on strengths and weaknesses of different methodological approaches in different societies and policy contexts, e.g. comparative ex-post evaluation of the process and outcomes in different cases across Europe, including views of researchers, decision makers and stakeholders. Integrate qualitative and semi-quantitative methodologies (i.e. fuzzy cognitive mapping, Bayesian belief networks, and deliberative techniques) with economic valuation approaches. Link the service providing unit (SPU) approach with stated preference methods. Develop better, expectation-based validity tests for stated-preference methods (scope sensitivity, substitutes and complements, influence of access regime on value estimates).

C. Enhance the usefulness of value, price and cost estimates by: (i) improving database coverage, quality, depth and access; (ii) filling key gaps in valuation evidence; (iii) investigating replication, validity and transfer of functional assumptions and values estimates; and (iv) developing agreed protocols for comparing and transferring value estimates.

- *Why is it important?* Primary valuation studies are expensive; transferring results to similar cases means better use of resources and makes valuation results available for cases in which primary studies would be disproportionate to the policy problem.

- *How can it be addressed?* Continued research on benefits-transfer methods, including meta-analyses of valuation studies. Fuller reporting of details of primary studies, including development of agreed standards and protocols. At European level, strategic approach to funding primary studies to fill key gaps in coverage and investment in making existing studies and meta-analyses easily available.

D. Improve methods for taking account of, and communicating, dynamic aspects, including: (i) risk/uncertainty in service provision; (ii) ecological thresholds, tipping points and irreversibility; (iii) evolutionary change of the system under valuation; and (iv) changes in economic systems, preferences and technologies.

- *Why is it important?* Through time, economic, social and environmental changes will influence values. Change can be discontinuous or abrupt, if there are thresholds or tipping points, and may be irreversible, uncertain, or both. The most likely outcome may be a poor indicator of the range of possible outcomes.

- *How can it be addressed?* All applications of valuation methods should attempt to explore and address possible issues relating to change, thresholds and uncertainty. Further research into ways in which these factors can be better incorporated within valuation methodologies, and accounting / decision support frameworks. Explore the potential of dynamic simulation models as normative benchmarks in assessing the sustainability properties of price paths.

E. Improve methods for the valuation of services at different scales, including methods for: (i) upscaling and downscaling; (ii) incorporating integrated assessment (long term and global) in valuation methods; and (iii) integrating valuation processes and results in impact assessments (EIA, SEA, SIA, etc) and IA models.

- *Why is it important?* Partly as a matter of making better use of valuation results (transfers to different scales), but also as a more fundamental matter of taking account of how values at one scale may be dependent on factors at other scales – the value of a resource/service at location L in region R will generally depend on the extent and/or distribution across R of (a) that resource/service, (b) human population and its characteristics and (c) other resources, services and infrastructure.

- *How can it be addressed?* Continued research in these areas, and in particular in developing interfaces between valuation or benefits-transfer methods and various decision support, assessment and modelling tools.

3.3 Indicators and trait-based approaches for ecosystem service assessment

Top five research priorities

A: Improve knowledge of trait-based multitrophic linkages within ecosystems

- *Why is it important?* Fundamental to the entire approach*;* benefits spill over into other fields.

- *How can it be addressed?* Improve knowledge of traits underlying ecosystem service provision (traits lists, databases and protocols).

B: Quantify changes in ecosystem service provision as a result of environmental pressures

- *Why is it important?* Feeds into policy support tools*;* basis for valuation*;* informs strategies at the ecosystem level to reduce pressures.

- *How can it be addressed?* Case studies; empirical approaches*;* modelling

C: Develop trait-based approaches, including trait-based thresholds (SPUs), to define quantitatively what constitutes adequate service provision. For example, service providing units must be defined in terms of the functional diversity necessary to provide a service at the required level.

- *Why is it important?* Necessary in order to assess how far away an ecosystem is from a working/functioning state*;* set goals and track progress towards habitat/ecosystem management.

- *How can it be addressed?* Case studies*;* empirical approaches*;* modelling; derived thresholds from natural ecosystems; assessment of demands of beneficiaries.

D: Identify where trait-based indicators can fill existing gaps in indication of ecosystem service provision.

- *Why is it important?* Unmet demand for ecosystem service indicators exists.

- *How can it be addressed?* Transfer traits into tangible, communicable and relevant indicators to address the target audience (indices, multimetrics, etc).

E: Scale up traits-based indicator approaches to broader scales.

- *Why is it important?* Landscape scales are common management scales*;* data can be accessed more easily at broader scales (e.g. remote sensing); data is more frequent but less detailed.

- *How can it be addressed?* Establish links between on-site data and remote sensing data*;* validate findings extensively.

3.4 Habitat management and conservation policy

Top five research priorities

A. Multi-level governance of ecosystem services – understanding drivers and levers.

- *Why is it important?* Communication and influencing.

- *How can it be addressed?* Systems analysis (key players and levers); survey of decision-makers and policies (stratified sample at smaller scales); triple bottom line: benefits in terms of value, what is the benefit?, who benefits? and social repercussions.

B. Tools, methods and decision-support systems for ecosystem service assessment integrated into a multifunctional toolkit.

- *Why is it important?* Enables simultaneous consideration and comparison of all aspects of ecosystem services, including sustainable development and informs decisions.

- *How can it be addressed?* Public benefit scoring system*;* multi-agent simulation models*;* multi-criteria analysis; instrument selection tree (e.g. TEEB – economic or other instruments depending on the situation, Defra report on economic instruments).

C. Multifunctional landscapes and ecosystem integrity.

- *Why is it important?* Ecosystem sustainability and integrity.

- *How can it be addressed?* Production possibility (frontier thresholds); land management (integrated modelling); land use extensification; precautionary approach; biodiversity cost-benefit analysis; conflict resolution.

D. Recognition of the role of small invertebrates, lower plants and fungi in ecosystem function and service provision.

- *Why is it important?* Known and potential importance of uncharismatic species.

- *How can it be addressed?* Primary research; identify proven indicators and surrogates that can be linked to policy; communication of their importance; web of life.

E. Linking landscape pattern and processes (ecosystem services) with land management.

- *Why is it important?* More holistic, integrated approach (avoids polarisation).

- *How can it be addressed?* Trait analysis; scale dependency threshold analysis, e.g. variability; multi-scale monitoring; structural heterogeneity.

4. Discussion, conclusions and next steps

The final plenary session included discussion of the following issues:

- The relationship between RUBICODE recommendations and those produced by EPBRS and those outlined in the MA follow-up strategy: this will be dealt with in the production of the roadmap for research.
- Expansion of the RUBICODE concept to developing countries. It was noted that good examples illustrating the RUBICODE framework exist in studies done in these countries. Research needs which would benefit from international cooperation will be highlighted in the roadmap for research.
- The key role of decision-making in the management of ecosystem services. The need for sociologists in research on decision-making was therefore stressed and the general need for transdisciplinarity in research acknowledged.
- The dispersed nature of information creates the need for a “network of knowledge” and improved interfaces between researchers and policy makers. Workshops, such as this one, are useful for exchanging ideas and building up a community and should be continued. The potential role of the RUBICODE approach in TEEB and MAII was identified.
- The value of agencies, such as the Federal Agency for Nature Conservation, in translating research findings for policy makers and, therefore, the benefit of including such agencies in research projects. The timeliness of advice was also acknowledged as important.

In conclusion, the workshop identified research priorities on ecosystem services and drivers of change; quantification and valuation of ecosystem services; indicators and trait-based approaches for ecosystem service assessment; and habitat management and conservation policy.

A roadmap for research will be produced based on these research priorities and those identified in the background paper for this workshop. These priorities will be rewritten in such a way that they are clear and attractive to both researchers and funders.

Acknowledgements

The RUBICODE consortium is grateful to all stakeholders who participated in the workshop and kindly offered their valuable input and to UFZ for hosting the workshop.

Annex I: Stakeholders participating in the workshop

Name	First name	Affiliation	Country
Basch	Gottlieb	European Conservation Agriculture Federation	Portugal
Boumans	Roelof	University Vermont	USA
Calvini	Marion	DEFRA	UK
Catchpole	Roger	Natural England	UK
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Herzog	Felix	Federal Department of Economic Affairs	Switzerland
Jax	Kurt	Helmholtz-Centre for Environmental Research - UFZ	Germany
Jones	Bruce	U.S. Geological Survey	USA
Kaemena	Astrid	European Commission, DG RESEARCH	Belgium
Korn	Horst	Federal Agency of Nature Conservation	Germany
Larkeson-Nowostaswki	Albert	Lund University	Sweden
Layke	Christian	World Resource Institute	USA
Levrel	Harold	Marine Economics Department	France
Ligetvary	Ferenc	Szent István University	Hungary
Luque	Sandra	Cemagref	France
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Müller	Felix	University of Kiel	Germany
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van Baalen	Jieles	Ministry of Agriculture, Nature and Food	Netherlands

		Quality	
van Wensem	Joke	TCB	Netherlands
Verghelet	Mircea	Romanian Forest Service	Romania
Watts	William	Environment Agency	UK
Wilke	Bern	Swiss Re	Switzerland
Zaunberger	Karin	European Commission, DG ENV	Belgium

Annex II: Project partners participating in the workshop

Name	First name	Affiliation	Country
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