



DIVERSITAS OSC2

BIODIVERSITY AND SOCIETY  
UNDERSTANDING CONNECTIONS, ADAPTING TO CHANGE

ABSTRACTS

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# Plenary speakers



**Brown George**, Lavelle Patrick, Jackson Louise, Brussaard Lijbert

**Unearthing below-ground biodiversity: Management and conservation implications**

Embrapa Florestas, Ecology, Brazil, browng@cnpf.embrapa.br

Plenary session

Soils are living entities and the home of a vast diversity of organisms, with a broad range of body sizes (from bacteria to earthworms), feeding strategies, and life habits. The great spatial and temporal variability in soils promotes a complex niche structure and an incredibly dense packing of species: a typical healthy soil may have a few species of vertebrates, springtails and oligochaetes, dozens of species of nematodes, spiders, mites and myriapods, more than one hundred species of insects and fungi and perhaps thousands of species of bacteria and actinomycetes. This may be the case even when the diversity of above-ground species is much lower, e.g., in agroecosystems. This myriad of animal and microbial community provides a range of essential functions and ecosystem services, including: biocontrol of pests, parasites and diseases; decomposition; nutrient cycling; carbon sequestration; soil formation; alteration of physical properties (especially porosity and aggregation), that affect soil stability, erodibility, gas exchanges, C sequestration, water runoff, infiltration and storage capacity; sources of food for indigenous human societies; plant pollination; plant growth control (both positive and/or negative). Nevertheless, this vital and dynamic subterranean ecosystem is often unrecognized, little understood and therefore mismanaged. Human decisions regarding landscape use and management play a crucial role in the determination of several factors important to the maintenance of active and beneficial soil communities. For instance, the conversion of natural habitats and the intensification of agriculture represent major threats to soil biodiversity and soil quality, but with appropriate landscape and farm management practices, negative effects can be abated and positive synergies can be promoted. Several international projects and initiatives are presently studying these issues, and the challenges involved and the progress obtained thus far will be explored.

**Keywords:** soils, biodiversity, agricultural sustainability, landscape, ecosystem services

**Daily Gretchen**, Polasky Stephen, Kareiva Peter, Goldstein Joshua, Pejchar Liba, Ricketts Taylor

**Ecosystem Services in Decision-Making: Time to Deliver**

Stanford University, Biology, USA, gdaily@stanford.edu

Plenary session

Over the past decade, efforts to value and protect ecosystem services have been promoted by many as the last best hope for making conservation mainstream – attractive and commonplace worldwide. In theory, if institutions recognize the values of Nature, then we can greatly enhance investments in conservation and foster human well-being at the same time. In practice, we have not yet developed the scientific basis, and the policy and finance mechanisms, for integrating natural capital into resource and land-use decisions on a large scale. We propose a conceptual framework and sketch a strategic plan to deliver on the promise of ecosystem services, drawing on emerging examples from around the world. We introduce InVEST, a decision-support system for quantifying the ecosystem services produced under alternative scenarios. And we describe the Natural Capital Project, an international effort to advance the science and practice of accounting for natural capital in the decisions of individuals, communities, corporations, and governments.

**Keywords:** biodiversity, InVEST, Natural Capital Project, production functions, tradeoffs

**Dobson Andrew**

**The ecological role of parasites and infectious disease in a changing world**

Princeton University, Department of Ecology & Evolutionary Biology, USA, dobson@Princeton.edu

Plenary session

The best available estimates suggest that parasitic species comprise around forty percent of biodiversity; the remaining 60% are hosts and essential resources for the parasitic species. These proportions could easily be reversed, we simply have too few people identifying and enumerating parasite biodiversity. Detailed examination of the few natural food-webs that have included parasites suggest that around 80% of the links involve a parasite species. We know from detailed field studies of a limited number of host-parasite systems that parasites can have profound impacts on host fitness and abundance. In this talk I will give examples from three or four different systems where we can examine the impact of parasitic species at the level of the host population, community level and at the level of the whole ecosystem. Geographically, we will visit the backyards of New England, the few remaining grasslands of California, the salt marshes of Mexico and the savannahs of East Africa. My ultimate goal is to persuade you that any understanding we have of how natural systems operate, or how we might manage them, will fall far short of being comprehensive if it ignores the central role that parasites and infectious disease play in determining their structure and function.

**Keywords:** parasite, foodweb, Serengeti, salt marsh, biodiversity

### Mace Georgina

#### **Biodiversity science and the post 2010 Biodiversity targets**

Imperial College London, Life Sciences, UK

Plenary session

Over the past 20 years there has been considerable progress in understanding how biodiversity underpins ecosystem processes and functions, and therefore how it contributes to ecosystem services. More recently, especially since the publication of the Millennium Ecosystem Assessment and the studies that developed from it, we understand the importance of recognising and valuing the full range of ecosystem services, and managing our ecosystems accordingly. These two lines of evidence can provide a firm footing for developing goals and targets for biodiversity. In this presentation I will discuss this in the context of targets to be adopted after 2010. I will outline some new approaches that can inform and be informed by biodiversity science.

**Keywords:** targets, ecosystems, policy, global, research priorities

### Midgley Guy

#### **Projecting biodiversity responses to climate change: Playing dice, dominoes, or just plain dubious?**

South African National Biodiversity Institute, Climate Change and Bioadaptation Division, South Africa,

midgley@sanbi.org

Plenary session

What are the best ways forward for projecting the responses of species, communities and ecosystems to climate change? Have such projections provided any useful information at all so far? Should we continue to refine and elaborate existing methods, or abandon them and invent new ones? Is the challenge currently simply beyond our ability? Are species responses stochastic and independent (dice model), or are they deterministic and interdependent (domino model)? These are all questions that continue to plague the community of ecologists engaged in projecting the impacts of climate change. It is important and urgent to make credible progress on this issue because there is a growing need to develop adaptive responses to climate change. The investment in adaptive responses for conservation and sustainable development objectives is likely to be dependent on the nature, the sensitivity, and the vulnerability of the biodiversity response. Up to now, a mixed bag of approaches has evolved to model the responses of species and higher levels of ecological organization to climate change. It is possible to identify a patchy landscape of methods with some areas of high skill interspersed with large knowledge and integration gaps. One way to make progress is to pursue the linking up of areas of expertise to create more coherent and self-consistent tool boxes. Ways to check the progression of impacts against projections will become increasingly critical to developing robust methods of projection. I will attempt to draw these threads together and suggest how a co-ordinated international focus could satisfy a key need for more reliable projections of biodiversity responses, and could provide guidance on where to play dice and where to play dominoes.

**Keywords:** climate change, biodiversity, uncertainty, fire, elevated CO<sub>2</sub>

### Muthiga Nyawira

#### **Linking science to management: the case of managing coral reefs in East Africa**

Wildlife Conservation Society, Marine Program, Kenya, nmuthiga@wcs.org

Plenary session

The marine and coastal resources of the East African region provide ecological, economic and social resources for millions of people. Anthropogenic pressures including overfishing and climate change threaten these resources. Contrary to expectations that the ecological and social diversity of the region will present insurmountable challenges, this very diversity provides opportunities for testing innovative ways to address management.

Drawing on research from scientists in the region, a case study of coral reefs is presented since reefs are the most diverse and ecologically important marine ecosystem in the region. The presentation outlines key findings from ecological and socio-economic studies focusing on the main pressures on reefs namely fishing and climate change. At the local level, the effectiveness of management was evaluated from a long-term monitoring program of coral reef communities while a regional level analysis of environmental and social susceptibility and the capacity to adapt to climate change was tested using data collected from ecological and socio-economic surveys after the widespread bleaching of 1998.

Findings from the evaluation of Marine Protected Area (MPA) effectiveness showed for example that top-down national management was most effective in no-take closures while gear management worked best when implemented at the local level with communities. The regional model showed that depending on environmental susceptibility and social adaptive capacity, communities could respond by large-scale protection of ecosystems, transforming and adapting social-ecological systems, building capacity to cope or using government assistance to reduce dependence on natural resources. The presentation concludes by discussing several national and regional policy options to enhance the ability of coral reef communities to adapt to climate change and the role of regional initiatives in growing the capacity for management in East Africa.

**Keywords:** coral reefs, East Africa, climate change, ecological susceptibility, adaptation

### **Sukhdev Pavan**

#### **TEEB and the colours of carbon: using nature to solve climate change**

UNEP-WCMC/Deutsche Bank London, UK-India

Plenary session

Investing in restoration and maintenance of the Earth's multi-trillion dollar ecosystems from forests and mangroves to wetlands and river basins can have a key role in countering climate change and climate-proofing vulnerable economies. This is among the central findings of a new climate issues update by The Economics of Ecosystems and Biodiversity (TEEB), a project launched by Germany and the European Commission in response to a proposal by the G8+5 Environment Ministers (Potsdam, Germany 2007) to develop a global study on the economics of biodiversity loss.

Our current emissions regime is largely a brown carbon regime which strives to contain fossil fuel energy use and restricts industrial GHG emissions. We need urgently to focus on green carbon, stored in terrestrial biomass and soils, as well as blue carbon, stored in the seas, if we want to make a serious impact on either removals or emissions reductions. We need to leverage the power and technology of Nature for effective, cost-efficient, and equitable mitigation and adaptation.”

**Keywords:** TEEB, climate change, biodiversity

# Symposiums overview



**Symposium S01:****Climate change and biodiversity: adaptive management in the face of uncertainty****Organisers**

- **Paul Leadley**, University Paris-Sud 11, France, paul.leadley@u-psud.fr
- **Belinda Reyers**, CSIR, South Africa, breyers@csir.co.za
- **Sandy Andelman**, Conservation International, s.andelman@conservation.org

Over the last several years, natural resources managers and policy makers have become acutely aware of the dangers that climate change poses for biodiversity. The most urgent request from these stakeholders to biodiversity researchers is for feedback on how to best develop adaptive management strategies. This is particularly true because significant investments have been made to manage biodiversity and the associated ecosystem services necessary for human wellbeing, but many of these investments (e.g. protected areas, water resource management) have been based on a static view of the world. We need to adapt our existing management strategies to safeguard biodiversity and ecosystem service security in the face of climate change. However, providing input for adaptive management will require new research strategies, since much more attention must be paid to quantifying the large uncertainties in projecting future changes in biodiversity. These uncertainties include those in climate change, land use and biodiversity response scenarios.

This symposium will bring together researchers working on terrestrial and marine ecosystems, who are actively engaging with natural resource managers to develop and implement adaptive management strategies. The symposium will feature overviews of recent perspectives in using biodiversity scenarios as part of developing adaptive management strategies. These will be followed by presentations by scientists from conservation organizations using case studies to highlight the challenges of putting into practice management strategies in the face of climate change.

**Contributors**

- **Paul Leadley:**  
Climate change and biodiversity: addressing the issues of uncertainty and costs in adaptive management
- **Richard Pearson:**  
Uncertainty in projections of biodiversity change for the 21st century
- **Dominique Bachelet:**  
Bridging the gap – improving science communication to land managers
- **Guy Midgley:**  
No more business as usual for conservation under climate change – the need to consider biodiversity as a security issue
- Russel Wise, Jonah Busch, Lee Hannah, Rebecca Shaw, **Belinda Reyers:**  
Determining the costs of conservation responses to climate change: case studies from global biodiversity hotspots
- **Sandy Andelman**, Michael Bode, Steve Polasky:  
The cost of ensuring global biodiversity security under climate change

**Symposium S02:****Evolution of biotic diversity in the Southern African winter-rainfall region****Organisers**

- **Hans Peter Linder**, University of Zurich, Switzerland, peter.linder@systbot.uzh.ch
- **George Anthony Verboom**, University of Cape Town, South Africa

The winter-rainfall region of Southern Africa includes two adjacent biodiversity hotspots: the Succulent Karoo, a largely semi-arid region on mesotrophic soils, and the Cape Flora, a more mesic region mostly on oligotrophic soils. The botanical diversity of these two regions has been well explored, and is with ca. 13'000 species and 70% endemism among the most species-rich globally. The region is famous for its unusual floristic composition, often dominated by the families Aizoaceae, Proteaceae, Ericaceae, Restionaceae and Iridaceae. There are still many poorly known aspects in the biota of this region, and many puzzling patterns. Very little is known about the diversity of invertebrates, even though the pollination syndromes in this region are very unusual. Furthermore, it is clear that there are still stranger pollination systems to be discovered, and that much is still to be learnt about the relationship between pollination systems and species. The high species-level endemism and diversity of the flora is not reflected in similar patterns in vertebrates, but the phylogeographical patterns in the vertebrates are complex and poorly-explored. In the past decade there has been a concerted effort to explore the evolution of this diversity, but with the massive focus on plants many aspects in the diversity of the animals have not received adequate attention. In this symposium we will review the most diverse components of this biota, and explore the patterns and potential processes that may have led to this astonishing diversity. We will discuss not only the plants of the two regions, but also the patterns and processes displayed by the vertebrate and invertebrates, as well as the interactions between plants and their pollinators.

**Contributors**

- **Hans Peter Linder**,  
George Anthony Verboom: The diversification of the Cape flora
- **Reto Nyffeler**, Klak Cornelia, Erika J. Edwards, Urs Eggli:  
Diversification of succulent plants in the winter-rainfall region of Southern Africa
- **Steven Johnson**:  
Plant diversification in Southern Africa: can studies of microevolution explain macroevolutionary patterns?
- **Michael Kuhlmann**:  
Bee diversity in the winter rainfall area
- **Conrad Matthee**, Nina Du Toit, Shelley Edwards, Jane Makokha, Belinda Swart, Sandi Willows-Munro:  
Patterns of faunal evolution in the Cape and Namaqualand
- **Ernst Swartz**, Paulette Bloomer, Albert Chakona, Mpho Ramoeljane, Paul Skelton:  
Ecological differentiation affects population history of two South African redfin species (*Pseudobarbus*, Cyprinidae) from the Cape Floristic Region

**Symposium S03:****The freshwater biodiversity crisis: a global threat to ecosystems and people****Organisers**

- **Klement Tockner**, Leibniz-Institute of Freshwater Ecology and Inland Fisheries, IGB, Germany
- **Charles Vörösmarty**, The city college of New York, USA

**Background & goal**

Few are aware of the catastrophic decline in freshwater biodiversity at both local and global scale. While freshwaters cover only 0.8% of the earth's surface, they contain ~10% of all animals. Compared with terrestrial and marine systems, they exhibit a 4-6 times higher extinction rate. Threats to freshwater biodiversity are growing and now global in scale. The implications to ecosystems and humans are immense because rivers, lakes, ground waters, and wetlands provide a diverse array of crucial natural functions and services; more than any other ecosystems. The uses of water are legitimate for both humans and Nature and we must collectively develop tools for its wise management.

The main goals are (i) to raise awareness about the dramatic situation in freshwater biodiversity, and the ecosystem services that are being lost as this biodiversity declines, (ii) to present sound information on status and rate of change of freshwater biodiversity, (iii) to suggest priority actions for supporting local and global biodiversity initiatives; (iv) articulating human-nature perspectives. This symposium is dedicated to a discussion of the science, the tools and the data sets that would be required for the community to execute integrated water system studies, but also the policy dimensions that address the issue of water needs for humans and for nature.

**Results & discussions**

Despite their pivotal ecological and economic importance, freshwaters have not been of primary concern in policy making. Therefore, the main outcomes of the symposium will be (i) a high-impact policy article on the topic, (ii) clear recommendations on future research needs, and (iii) clear recommendations on strategy actions. Work executed over the last several years in two concurrent ESSP efforts, the Global Water System Project and DIVERSITAS, poises us to jointly and in short order execute a similar analysis of emerging threats to fresh water on the continental land mass.

**Contributors**

- **Charles Vörösmarty:**  
Humans transforming the global water system: what does this mean for nature?
- **David Dudgeon:**  
Freshwater biodiversity in the Anthropocene
- **Caroline Sullivan:**  
Understanding the anthropocentric value of wetland functionality as a means of supporting habitat protection and freshwater biodiversity
- **Bradley Cardinale:**  
What fraction of species do we need to maintain a functioning ecosystem?
- **Klement Tockner, Joerg Freyhof, Daniel Hering, Nike Sommerwerk, Diego Tonolla, Markus Venhor:**  
Setting priorities for conserving freshwater biodiversity at the catchments scale
- **Margaret Palmer:**  
River futures: can we recover lost biodiversity and ecosystem function?

### **Symposium S04:**

### **Creating sustainable multifunctional landscapes: lessons from transdisciplinary programmes**

#### **Organiser**

- **Patrick O'Farrell**, CSIR, South Africa, pofarrell@csir.co.za

Sustainable development can only be achieved if the use of natural capital and the ecosystem services that flow from it, proceed at rates equitable to its regeneration. This limit to growth has not been effectively captured by markers or incorporated into land use planning and decision making. This has resulted in landscape degradation, and compromised human-welfare and development trajectories. Remaining natural capital needs to be appropriately utilised through appropriate landscape planning and management, and restored where landscapes have become degraded. These are enormous scientific and practical challenges requiring transdisciplinary interaction. Research emphasis should be placed on understanding 1) how natural capital and its components function and how these are interlinked, 2) the value, possible trade-offs, regeneration costs, and potential markets for this capital, 3) the temporal and spatial scales of supply and demand of services, 4) the institutional and legal perceptions of, and barriers to effective management, and the determination of appropriate governance systems. This knowledge must be developed in partnership with local stakeholders. This symposium presents the results from ongoing transdisciplinary research collaborations between Europe and Southern Africa, that have brought scientists, students, stakeholders and key implementing agencies together to generate user demanded, and user useful knowledge. Presentations highlight activities that can contribute to improved service provision under scenarios of change, economic instruments for valuing natural capital and its restoration, and understanding trade-offs and stakeholder willingness to restore. The symposium will conclude with a panel discussion on the role of transdisciplinary learning organisations for fostering sustainable futures.

#### **Contributors**

- **Richard Cowling**, Christo Marais, Anthony Mills, Mike Powell, Ayanda Sigwela:  
Transdisciplinary learning organisations, restoration and carbon
- **James Blignaut**:  
PES and human welfare
- **Rudolf De Groot**:  
TEEB: The Economics of Ecosystems and Biodiversity
- **Thomas Elmqvist**:  
Creating sustainable multifunctional landscapes: lessons from transdisciplinary programmes
- **Lisen Schultz, Cecilia Lundholm**:  
Local stewards, learning and management of ecosystem services: examples from Biosphere Reserves
- **Belinda Reyers**, Greg Forsyth, Patrick O'Farrell, Cowling Richard, Annelise Schutte-Vlok, Jan Vlok:  
Building sustainable landscapes in a semi-arid biodiversity hotspot
- **Patrick O'Farrell**, Philippa Anderson, David Le Maitre, Belinda Reyers:  
Tools for creating multifunctional landscapes

## **Symposium S05:** **Biodiversity change and human well-being**

### **Organisers**

- **Kamaljit S Bawa**, University of Massachusetts, USA/India, kamal.bawa@umb.edu
- **Lele Sharadchandra**, Ashoka Trust for Research in Ecology and the Environment, India, slele@atree.org

Humans are major drivers of changes in biological diversity. Changes in biological diversity in turn affect human well-being. The reciprocal effects of humans on changes in biodiversity and of changes in biodiversity on humans are not well understood. The International Union of Biological Sciences (IUBS) has initiated a program on Human Dimensions of Biodiversity Change. One of the objectives of the program is to examine the reciprocal relationship between biodiversity change and human well being. Specifically the program will focus on three sets of questions:

- (a) Which human actions have the most effect on biodiversity? What are the ultimate drivers of these activities? (b) What are the consequences of changes in biological diversity for humans? How are they distributed across regions, classes and gender?  
 (c) What should be society's responses to biodiversity changes and to the consequences of these changes on human well being? When and why are current responses inadequate or ineffective?

### **Contributors**

- **Sharachchandra Lele:**  
Markets or governance? Contrasting approaches to biodiversity conservation
- **Sunita Facknath:**  
Drivers of biodiversity loss in Africa, and social and policy responses
- **Daniel Brockington:**  
Marketing conservation: capitalism and neoliberal conservation
- **Joyce Kinabo:**  
Do social and cultural responses to biodiversity loss benefit the poor
- **Kamaljit S Bawa**, Reinmar Seidler:  
Progress and potentials of community-based conservation and development in South Asia
- **Peter Wilshusen:**  
Conservation futures: a review of the political and normative dimensions of biodiversity conservation initiatives

### Symposium S06: Biofuels and Biodiversity

#### **Organiser**

- **Pieter Baas**, Leiden University, The Netherlands

The current debate on large-scale production of biofuels is mainly focused on competition for arable land needed for food production and the limited or even negative contribution of biofuel crops to the desired global reduction of carbon dioxide emissions. There are also major impacts of biofuel production on biodiversity that need to be fully understood in order to underpin sustainable energy policies. This symposium will address the following themes:

- Biofuels of different kinds - and their real or potential interactions with biodiversity – a review.
- Biofuel/Conservation competition in the tropics and in temperate regions
- Biofuel species as invasives
- Algae and micro-organisms for sustainable biofuel production?
- Biofuels, biodiversity and the human dimension (social aspects in local economies).

Other themes may be included as insights evolve and new data become available

#### **Contributors**

- **Pieter Baas:**  
Introduction
- **Rik Leemans:**  
The myths of using forest for biofuels: flawed promises risk biodiversity, climate and sustainability
- **Daniel Murdiyarso:**  
Deforestation, biofuels and biodiversity in Southeast Asia - the oil palm dilemma
- **Luciano M Verdade**, Luiz A Martinelli:  
The impacts of biofuel on biodiversity in Brazil
- **Jens Dauber**, Jane Stout, Mark Emmerson, Erin O'Rourke, Dara Stanley, Rosalyn Thompson, Jesko Zimmermann, Mike Jones:  
The impact of bioenergy crop cultivation on temperate biodiversity and ecosystem services
- **Arne Witt:**  
Biofuels and invasive species from an African perspective
- **Rene H Wijffels:**  
Microalgae for production of bulk chemicals and biofuels

**Symposium S07:****Analysis and forecasting of biodiversity and ecosystem processes: a contribution to GEO BON****Organisers**

- **Tetsukazu Yahara**, Kyushu University, Japan
- **Markus Fischer**, University of Bern, Switzerland, markus.fischer@ips.unibe.ch
- **Carlos Joly**, UNICAMP and BIOTA/FAPESP, Brazil

Biodiversity changes including deterioration and losses are on-going at multiple levels, including ecosystem, species, and gene. However, observations to quantify those biodiversity changes at the global scale are still in their infancy. Recently, the Group on Earth Observations Biodiversity Observation Network (GEO BON) was launched to improve this situation, and provide assessments and forecasts, based on observations and models, of biodiversity change by performing integrative data analysis. The aim of GEO BON is not only to coordinate new observations but also to organize the synthesis of available data to illustrate how rapidly biodiversity is being lost at the global scale. One of the major difficulties to be overcome is to create systems whereby available data can be combined. There are very few attempts to combine well-replicated assessments of biodiversity states at the ecosystem, species, and gene levels with assessments of population and ecosystem processes in various spatial and temporal scales.

The goal of this symposium is to contribute to provide a platform of exchange of knowledge between leading biodiversity observation projects that have taken this comprehensive approach, promote discussion about how to merge biodiversity observations on states and processes at the ecosystem, species, and gene levels, and draft a position paper on how to improve coordination of such research, in the context of GEO BON.

**Contributors**

- **Tetsukazu Yahara:**  
Challenges to develop biodiversity observation networks at ecosystem, species and gene levels
- **Carlos A Joly**, Ricardo Ribeiro Rodrigues:  
The BIOTA/FAPESP Program: a successful Brazilian experience to use scientific data to improve biodiversity conservation and sustainable use in Sao Paulo State, Brazil
- **Robert Scholes:**  
Toward a Global Biodiversity Observing System
- **Motomi Ito:**  
Importance of genetic data in comprehensive assessments of biodiversity
- **Norbert Jürgens:**  
Standardised biodiversity monitoring within the BIOTA AFRICA network: lessons learnt after 8 years of standardised biodiversity monitoring covering real landscapes of all major biomes of Africa
- **Michael Keller**, Thomas J Stohlgren:  
The U.S. National Ecological Observatory Network (NEON): an infrastructure to enable analysis and forecasting of biodiversity and ecosystem processes at a national scale
- **Markus Fischer:**  
The German biodiversity exploratories as a model for integrated biodiversity monitoring

### Symposium S08:

### Spatial marine management and new approaches to marine ecology: a way out of the black box?

#### **Organiser**

- **David Kaplan**, IRD, France, david.kaplan@ird.fr

Spatial marine management, including marine protected areas and zonation of fisheries management, has generated enormous interest over the last decade and has great potential for addressing current problems of overfishing and loss of marine biodiversity. Nevertheless, effective spatial management rests on understanding many aspects of the dynamics of marine metapopulations that have traditionally been difficult or impossible to accurately assess: spatial connectivity, trophic interactions, marine habitat and biodiversity distributions, and genetic structuring. A number of recent technological, methodological and modeling developments promise to improve our understanding of these fundamental questions in marine ecology. A few examples: genetic analyses and electronic markers are dramatically increasing our understanding of connectivity, isotopes and chemical analyses provide insight into ecosystem functioning, and improvements in modeling techniques give increasingly detailed visions of the oceanographic, biologic and anthropogenic factors that determine spatial patterns of marine biodiversity. Nonetheless, exactly how to best integrate this complex and detailed knowledge into spatial marine management decisions remains a major challenge. In this symposium, we propose an open discussion of these new developments and their potential impact on the future of spatial marine management.

#### **Contributors**

- **David Kaplan:**  
Introduction
- **Jean-Yves Georges**, Sabrina Fossette, Philippe Gaspar, Charlotte Girard, Virginie Plot:  
Atlantic leatherback high use areas and hotspots
- **Colin Attwood**, Paul Cowley, Sven Kerwath, Tor Næse, Eva Thorstad, Finn Økland, Chris Wilke:  
Protection of a migratory fish population in a coastal marine protected area
- **Timothée Brochier:**  
Using an evolutionary model of larval dispersal to map small pelagic fish reproduction "hot spots"
- **Rocio Moreno-Sanchez**, Jorge Maldonado:  
Can co-management improve governance of a common-pool resource? Lessons from a framed field experiment in a marine protected area in the Colombian Caribbean
- **Mark Emmerson**, Eoin O’Gorman:  
Intact ecosystems are robust to climatic forcing

**Symposium S09:****Economic instruments for biodiversity conservation and ecosystem services****Organisers**

- **Irene Ring**, Helmholtz Centre for Environmental Research – UFZ, Germany, irene.ring@ufz.de
- **Astrid Van Teeffelen**, Wageningen University, The Netherlands, astrid.vanteeffelen@wur.nl

Economic instruments such as tradable permits and fiscal transfers are gaining attention as policy instruments to protect biodiversity. In a system of tradable permits, habitat banks are created to generate biodiversity credits, which are next sold to land users or investors to offset habitat loss elsewhere. Compared to top-down planning, such a policy may have benefits in terms of cost-effectiveness. Yet, the conditions under which such benefits can be realized are not well understood. Under fiscal transfer schemes, public revenue is redistributed through transfers from national and regional governments to local governments. Ecological fiscal transfers compensate local governments for expenditure incurred in providing public goods and services with spillover benefits to areas beyond their boundaries.

Simultaneously, carbon sequestration and CO<sup>2</sup> emissions trading are being implemented at large scales to slow down climate change, along with initiatives to reduce emissions from deforestation and degradation (REDD) by providing international payments for forest conservation. Linking biodiversity conservation and climate protection through tradable permit markets or fiscal transfers may provide synergies, but can also involve trade-offs.

The goals of this symposium are threefold: First, it aims to better understand the potential and limitations of tradable permits and fiscal transfers for biodiversity conservation. Determining the conditions under which these instruments can meet conservation goals requires a multidisciplinary approach, including ecological, policy and economic perspectives. Second, it highlights the synergies and trade-offs between biodiversity and climate policies for tradable permits and ecological fiscal transfers. Third, it presents experiences from developing and developed countries with tradable permit and fiscal transfer schemes for biodiversity conservation at different stages of the policy cycle.

**Contributors**

- **Irene Ring and Astrid Van Teeffelen:**  
Introduction
- **Martin Drechsler**, Karin Johst, Paul Opdam, Astrid Van Teeffelen, Claire Vos, Frank Wätzold:  
Opportunities and constraints of tradable permits for biodiversity conservation
- **Oscar Venter**, Richard Fuller, Takuya Iwamura, Hugh Possingham, Kerrie Wilson:  
Conserving forest biodiversity through global efforts to reduce carbon emissions from deforestation
- **Stephen Polasky:**  
A landscape level analysis of trade-offs and synergies on carbon sequestration and biodiversity conservation
- **Rui Santos**, Paula Antunes, Irene Ring:  
Fiscal transfers for biodiversity conservation: experiences and prospects
- **Silvia Irawan**, Luca Tacconi:  
Deforestation and ecological fiscal transfers in Indonesia
- **Surender Kumar**, Shunsuke Managi:  
Compensation for environmental services and intergovernmental fiscal transfers in India

### **Symposium S10:** **Management tools for marine biodiversity**

#### **Organisers**

- **Melanie Austen**, Plymouth Marine Laboratory, UK, mcva@pml.ac.uk
- **Michel De Lara**, University Paris-Est - CERMICS, France, delara@cermics.enpc.fr

Approximately 44% of the World's population lives within 150 km of the coast. This is predicted to rise to nearly 75% within two decades, further increasing demands and pressures on marine ecosystems and their biodiversity. Internationally, legislation is being developed to facilitate better management of human activity in the marine environment to enable fairer use of its resources, sustainable development and maximum benefit for all.

Sustainable marine management needs tools to compare relative costs and benefits of different activities and their environmental impacts; to reflect concerns such as precaution, conservation and production; and to include risk indicators. However, trade-offs between ecological risks and economic indicators (catches profit, gross product) are not often made explicit. Monetary value is one of the dimensions by which the importance of biodiversity elements can be estimated, but it cannot be easily ascribed to ecosystem services regarded as non-use, for which there is no market, such as amenity, existence, and inspirational. Other social science approaches can provide complementary insight into the values people hold.

Quantifying how societal benefits are impacted by different marine management options requires fundamental understanding of the biodiversity-ecosystem function- ecosystem service relationships and of the impacts of anthropogenic impacts, as well as global change impacts on these relationships.

The session will focus on research that:

- Improves our understanding of the biodiversity-ecosystem function- ecosystem service relationships;
- Quantifies the societal benefits or value of marine biodiversity and how human activities and global change impact upon these benefits and values;
- Investigates different value systems that reflect the range of value systems held by society;
- Deals with conflicting objectives for systems which are both dynamic and uncertain.

#### **Contributors**

- **Michel De Lara**, Eladio Ocana, Ricardo Oliveros-Ramos, Jorge Tam:  
Sustainable quotas and viable management of ecosystems
- **Vincent Martinet**:  
Ecosystem-based fishery management and stochastic viability assessment
- **Jorge Maldonado**, Rocio Moreno-Sanchez:  
Does scarcity exacerbate the tragedy of the commons? Evidence from fishers' experimental responses
- Per Olsson, **Franciska Rosen**:  
Navigating the transition to ecosystem-based management of the Great Barrier Reef, Australia

**Symposium S11:****Effective governance for ecosystem services: the challenge of matching temporal and spatial scales****Organisers**

- **Stephen Polasky**, University of Minnesota, USA, polasky@umn.edu
- **Anantha Duraipah**, United Nations Environment Programme, Kenya

This symposium will address the challenge of designing governance institutions to achieve sustainable and equitable supply of ecosystem services. The Millennium Ecosystem Assessment argued that part of the explanation for declining ecosystem services is the spatial and temporal mismatch in scales between environmental impacts and decision-making. The symposium will address issues in scale mismatch and institutional failure and make suggestions for reforms or new institutions. In addition, the symposium will address issues related to the design of institutions to account for equitable access and distribution of ecosystem service benefits. The symposium will cover the spectrum of services and governance from the very local (e.g., pollination and land use; water quality, flood control and watershed management), to the global (e.g., climate change and the UN Framework Convention on Climate Change). The presentation will also cover the spectrum of potential institutions including changing social norms, markets, and government policies (and combinations such as cap-and-trade schemes and payments-for-ecosystem services). Presentations will be followed by a panel discussion.

**Contributors**

- **Anantha Kumar Duraipah:**  
Equitable access and use of ecosystem services: some insights on governance
- **Thomas Elmqvist:**  
Effective governance of urban ecosystem services
- **Charles Perrings:**  
The governance of international environmental public goods
- **Stephen Polasky:**  
Effective governance for "mainstreaming" ecosystem services

### **Symposium S12:** **Genetic drivers of freshwater biodiversity**

#### **Organiser**

- **Koen Martens**, Royal Belgian Institute of Natural Sciences, Belgium

Biodiversity comprises diversity at three main levels: genes, taxa and ecosystems. Of these, the genetic level is often underrepresented in classic biodiversity studies, although it is often at the basis of biodiversity manifesting at the other two levels. The present symposium will bring together key contributions relating to patterns and processes of molecular and genetic diversity that are relevant to taxonomic and ecosystem-level biodiversity in freshwaters.

Freshwater habitats comprise only 0.01% of the Earth's total water volume and about 0.8% of the total surface of the planet. Yet, more than 9% of all known animal species, including 40% of all known fish species and therefore about one fourth of all vertebrate species, occur in lakes, rivers, ponds and ground water, a situation known as the paradox of freshwater.

In the proposed symposium, we aim to assemble a series of oral presentations and posters that contribute to understanding the freshwater paradox, primarily through contributions focusing on genetic drivers of freshwater biodiversity. The symposium will be open to a wide range of subtopics, including:

- discovery of cryptic species (through bar coding or other molecular methods);
- speciation and extinction driven at molecular and genetic levels (hybridization, sexual versus asexual reproduction, etc.);
- genetic diversity in hotspots such as ancient lakes;
- anthropogenic effects on populations of endangered species with low standing genetic variability;
- environmental changes through global (climate) change and their effect on genetic diversity of fragmented populations;
- effects of changing genetic diversities in populations on ecosystem services.

#### **Contributors**

- Isa Schon, Bill Birky Jr, Saskia Bode, Roger K Butlin, Stuart Halse, **Koen Martens**:  
Cryptic species in non-marine ostracods
- **Erik Verheyen**:  
Exploration of biodiversity patterns and evolutionary histories of Central African freshwater fish faunas
- **Christian Sturmbauer**:  
New insights on explosive speciation and adaptive radiation from East African cichlid fishes
- **Elie Verleyen**, Luc De Meester, Koen Martens, Katleen Van Der Gucht, Wim Vyverman:  
Patterns in microbial diversity and community structure at multiple spatial scales
- **Cyprian Katongo**:  
Evolutionary Biology of Freshwater Fishes of Africa
- **Ricardo L Pinto**, Koen Martens, Isa Schön:  
Genetic diversity in ancient asexual ostracods

**Symposium S13:****Mining biodiversity databases: examples for mountain biota and conservation planning****Organisers**

- **Christian Körner**, University of Basel, Switzerland, [ch.koerner@unibas.ch](mailto:ch.koerner@unibas.ch)
- **Carlos Joly**, UNICAMP and BIOTA/FAPESP, Brazil

Primary biodiversity data such as biological specimens or species observations being collected and deposited in museum collections become more and more available, due to initiatives like the Global Biodiversity Information Facility (GBIF) and others. These existing and emerging electronic databases are among the most promising tools in biodiversity research, and a huge opportunity to improve policy-maker decisions on biodiversity conservation.

The wide range of climatic conditions and topographies across the world's mountains offers an unparalleled opportunity for developing and testing biodiversity theory. Geo-referenced biodiversity data bases can be linked with geo-statistical information systems to answer basic questions of the causes and trends of biodiversity. Gradients of altitude and associated climatic trends, topographic and soil peculiarities, fragmentation and connectivity among biota and their varied geological and phylogenetic history are the major drivers and aspects of mountain biodiversity, and electronic archives provide avenues for testing their impact on life at high elevations. Georeferenced biodiversity data can also be used to derive climate change dynamic impact scenarios, suggesting upward migration of many mountain species and possible regional disappearance when no suitable habitat is available at higher elevations.

The Research program on characterization, conservation and sustainable use of the biodiversity of the State of São Paulo, called "BIOTA/FAPESP, The Virtual Institute of Biodiversity" (<http://www.biota.org.br>) presents a showcase on how to improve the conservation of a tropical area very rich in biodiversity. The project used a standard protocol to register sampling of all taxa (plants, animals, fungi and microorganisms), and to recover data available in biological collections. An online portal is linking the georeferenced biological databases with maps of native vegetation remnants, in order to establish conservation priorities, which were already adopted by the Secretary of Environment of the State of São Paulo.

**Contributors**

- **Falk Huettmann:**  
Towards a digital culture for the world's mountains, polar regions and beyond: supporting adaptive management for a global sustainability
- **Mary T K Arroyo:**  
Using georeferenced plant specimen data for detecting macroecological patterns in the South American Andes: searching for a relationship between latitudinal and altitudinal ranges
- **Christophe Randin**, Robin Engler, Antoine Guisan, Pascal Vittoz:  
Using georeferenced databases to assess the effect of climate change on alpine plant species and diversity
- **Carlos A Joly**, Ricardo Ribeiro Rodrigues:  
The BIOTA/FAPESP Programme as a successful initiative
- **Jean Paul Metzger**, Carlos A Joly, Ricardo Ribeiro Rodrigues:  
Parameters to establish priority areas for terrestrial biodiversity conservation and restoration
- **Lilian Casatti**, Francisco Langeani, Naécio Aquino Menezes, Osvaldo Takeshi Oyakawa & Francisco Manoel de Souza Braga:  
Parameters to establish priority areas for freshwater biodiversity conservation and restoration

**Symposium S14:****Biodiversity and agricultural sustainability: from assessment to adaptive management****Organisers**

- **Louise Jackson**, University of California Davis, USA, Lejackson@ucdavis.edu
- **Meine Van Noordwijk**, ICRAF, Indonesia

In the developing world, agrobiodiversity has the potential to confer resilience to human-induced environmental change, and thereby contribute to achieving the Millennium Development Goals (MDGs). This is an enormous challenge which is further complicated by the deepening effects of the global food crisis and climate change. Current agricultural development policies are not designed to realize the potential of agricultural biodiversity in improving the livelihoods of the world's poorest peoples, or for the public good. Instead, they exacerbate the tradeoffs between conservation and sustainable use. This symposium will examine how using and conserving agrobiodiversity can contribute to greater resilience and sustainability (how sustainability and agility adapt to changing conditions in coupled ecological and social systems, Verchot et al., 2007). It will also consider the requirements for an enabling environment and social capital for realizing sustainable biodiversity management as a key path to improving rural livelihoods.

Recent examples show several ways in which biodiversity management can contribute to improved livelihoods: by improving productivity and resilience of farming systems, and by diversifying sources of income. However, new, truly innovative strategies are needed for this purpose, and to set up procedures by which farmers and other stakeholders receive rewards and recognition for their efforts. The talks in this symposium will emphasize what works in certain landscapes, and why, and explain the need for biophysical data showing how biodiversity is linked to ecosystem functions, for socioeconomic data on the incentives that will ensure stakeholder participation, and for an integrative process that benefits both the providers and beneficiaries of ecosystem services over the long-term. The symposium is supported by Bioversity International, the UN Food and Agriculture Organization, and the DIVERSITAS agroBIODIVERSITY network.

**Contributors**

- **Jan Bengtsson:**  
Biodiversity and resilience: theory and outcomes in agricultural landscapes
- **Raymond Vodouhe,** Didier Balma, Baina Danjimo, Mikkel Grum, Amadou Sidibe, Melinda Smale:  
Diversity field fora: a participatory approach to management of crop diversity for greater resilience and sustainability in West and Central Africa
- **Mohammed Said,** Norbert Henninger, Janet Nackoney, Paul Okwi, Godfrey Ndeng'e, Florence Landsberg, Patti Kristjanson, Robin Reid, Dan Tunstall, Greg Mock:  
Using geospatial information to connect ecosystem services and human well-being in Kenya
- **William Foster,** Jake Snaddon, Edgar Turner:  
Do oil palm plantations have to be green deserts?
- **Meine Van Noordwijk:**  
Climate change, agrobiodiversity and sustainability in agroforestry systems
- **Leslie Lipper:**  
Linking payments for ecosystem services to sustainable land management in Africa

**Symposium S15:****Research for adaptive management of biodiversity-rich tropical landscape mosaics****Organisers**

- **Jean-Laurent Pfund**, CIFOR (Center for International Forestry Research), Indonesia, j.pfund@cgiar.org
- **Robert Nasi**, CIFOR (Center for International Forestry Research), Indonesia, r.nasi@cgiar.org

**Background and Goal**

Scientists and conservationists have become aware that conservation approaches based on targeting threats and establishing protected areas are necessary but not sufficient. Production forests, forest patches, secondary forests, agroforests and plantations play a key role for biodiversity conservation in the tropics. They are often beyond the direct control of the governments and their institutions and subject to pressures originating from sustaining people's livelihoods or conversion to more profitable agricultural systems. To address these issues, The Center for International Forestry Research (CIFOR) and the World Agroforestry Centre have developed and tested action research frameworks for supporting landscape-scale management processes. The approaches consider the spatial distribution of forests and the services they provide, demands from local communities and other actors regarding forest resource management, and address governance and land-use planning issues.

Based on a comparison of various tropical landscape conditions, the goal of the symposium is to contribute to new ways of conducting research in landscape mosaics to support the integration of biodiversity conservation into adaptive management processes.

**Results and discussion**

Presentations will highlight the relationships between biodiversity conservation and livelihood uses, landscape patterns, incentives for conservation and governance in selected landscapes. The discussion will consider multidisciplinary options to assess and monitor landscape mosaics and how research which can catalyze adaptive management should be undertaken.

**Conclusions**

The findings will be used to define relevant variables to assess and monitor tropical landscapes in view of supporting adaptive and multifunctional management. The experiences and salient points will be synthesized to discuss transdisciplinary research approaches. The results will be presented in journals and in wider-ranging media.

**Contributors**

- Lena Gustafsson, **Yves Laumonier**, Robert Nasi:  
Reviewed knowledge on plant ecology give guidance on how to integrate biodiversity-concern into tropical forestry in Southeast Asia
- **Terry Sunderland**, Jean-Laurent Pfund:  
Key information for landscape assessment, planning and monitoring
- **Sonya Dewi**, Andree Ekadinata, Jean-Laurent Pfund, Meine Van Noordwijk:  
Spatial tradeoff analysis of environmental goods and services in forested landscapes
- **Carol J Pierce Colfer**:  
Action research for catalyzing adaptive management – the critical role of local and decentralized institutions
- **Judith Kruger**:  
Analysing biodiversity monitoring data: are we succeeding in analysing data in time to enable us to apply adaptive management principles successfully?
- **Sven Wunder**:  
Can environmental services from complex landscapes be sold?

### Symposium S16:

#### Evolution: the past, present and future of biodiversity

##### **Organisers**

- **Andrew Hendry**, McGill University, Canada, [andrew.hendry@mcgill.ca](mailto:andrew.hendry@mcgill.ca)
- **Michael Donoghue**, Yale University, USA, [Michael.donoghue@yale.edu](mailto:Michael.donoghue@yale.edu)

##### **Background and Goal of the Symposium:**

Biodiversity is the product of past evolutionary processes. Reconstructing evolutionary history is therefore critical for understanding biodiversity in the present. Furthermore, biodiversity in the future will be strongly influenced by current and future evolutionary processes. The goal of this symposium is to explore how research on evolutionary patterns and processes helps us to understand the past, present, and future of biodiversity.

##### **Results and Discussion:**

The symposium will address the role of evolution in biodiversity through several main issues.

- (1) The assembly of communities through evolution and migration.
- (2) The structuring of neutral and adaptive genetic variation through space and time.
- (3) The potential for populations and species to respond adaptively to environmental change.
- (4) The influence of rapid evolution on ecological processes, such as food webs and nutrient cycling.

##### **Conclusion:**

Evolution is the key to understanding the history and current structure of biodiversity. It is also an aid to predicting the future of biodiversity and to improving strategies for its protection.

##### **Contributors**

- **Andrew Hendry:**  
Humans, evolution, and future of biodiversity
- **Ole Seehausen:**  
Loss of diversity through the reversal of speciation
- **Toby Pennington**, Matt Lavin, Reynaldo Linares, Ary Oliveira Filho, Jay Rotella:  
Evolution of dry forest in South America
- **Susana Magallon**, Isolda Luna-Vega:  
Phylogenetic composition of flowering plant diversity in the cloud forest of Mexico
- **Erika Edwards:**  
C<sub>4</sub> photosynthesis and climate change
- **Eric Palkovacs:**  
Evolutionary influences on ecological processes

**Symposium S17:****The role of biodiversity for ecosystem processes and services under climate change****Organisers**

- **Michael Scherer-Lorenzen**, Institute of Plant Sciences, Switzerland, michael.scherer@biologie.uni-freiburg.de
- **Yiqi Luo**, University of Oklahoma, USA, yluo@ou.edu

**Background and goals**

The World's forest and grassland ecosystems harbour the majority of terrestrial biodiversity, they play a key role in global biogeochemical cycles, and they are the source of numerous ecosystem services on which mankind directly depends on. Species composition in forests and grasslands reflects outcomes of interactions among organisms under a set of environmental conditions. Climate change alters essential environmental conditions (such as temperature, soil nutrient dynamics, and water availabilities) and results in changes in species composition. Changes in species composition and community structure have long-term impacts on ecosystem functioning and the delivery of ecosystem services. While the functional linkages between biodiversity, ecosystem processes and the delivery of goods and services are relatively well known for fast-growing, small statured grassland model systems, we still lack this knowledge for long-lived and more complex forest ecosystems.

**Results and discussion**

This symposium aims to summarize our understanding of the functional ecology of forests and grasslands with a special focus on ecological processes that are directly related to the delivery of ecosystem services. It brings together experts, who have studied changes in biological diversity and ecosystem functions under global change, to share their major results, discuss key research challenges and future research directions to advance our predictive understanding in this field.

**Conclusions**

The ability of the World's ecosystems to sustainably provide services to society in face of ongoing global changes will presumably depend to a large degree on the functional diversity of both above- and belowground organisms. Understanding the biodiversity-function relationships will thus not only be crucial for ecosystem conservation and management, but also for safeguarding human well-being.

**Contributors**

- **Yiqi Luo:**  
Grassland biodiversity and ecosystem functions under climate change
- **Christian Wirth**, Michael Scherer-Lorenzen:  
The functional role of tree species diversity: changing patterns under climate change?
- **Christian Körner:**  
Forest and grassland diversity controls ecosystem responses to a CO<sup>2</sup> rich future
- **Jizhong Zhou:**  
Metagenomic analysis of the feedback responses of soil microbial communities to elevated CO<sup>2</sup>
- **Jeffrey Dukes:**  
Climate change effects in grasslands: biodiversity and ecosystem services
- **Peter Manning:**  
Disentangling direct and compositional effects of climate change on ecosystem functioning

**Symposium S18:****Globalization and invasive species: national responses, international options****Organisers**

- **Charles Perrings**, ASU, School of Life Sciences, USA
- **David Richardson**, Stellenbosch University, South Africa, rich@sun.ac.za

**Background and Goal of the symposium:**

One major effect of globalization is an increase in introduction of new species to ecosystems. Another is an increase in the vulnerability of those systems as a result of habitat fragmentation, and the development of barriers and pathways. These two effects have led to damage to human, animal and plant communities from invasive pests and pathogens, as well as the disruption or loss of important ecosystem services. The symposium will use case studies to explore national responses to existing and potential invaders.

**Materials and methods:**

The papers in the symposium will address three main issues:

- Impacts of globalization on the introduction of potentially invasive species and options for international cooperation and coordination to mitigate trade-related Invasive Species (IS) risks.
- The mitigation of national risks from introduced species through inspection and interception (management of trade-related risks from invasive species in the USA and Australia).
- National adaptation to the presence of established invasive species through control and exploitation (lantana in India; boundaries as barriers or pathways of invasion in protected areas in South Africa).

**Results and discussion:**

From a policy perspective, IS are an externality of international trade, and the options for dealing with them vary with the spatial and temporal scale at which the problem is addressed. Two main strategies are involved: mitigation (preventive action to reduce risks) and adaptation (control or exploitation after the fact). The symposium will consider the range of responses open to national governments, including international cooperation on sanitary and phytosanitary measures, border protection against trade-related species introductions, eradication and control of established invasive species, and commercial exploitation of invasive species.

**Contributors**

- **David Richardson:**  
Introduction
- **Charles Perrings:**  
Globalization and the dispersion of species: the economic problem
- **Mike Springborn:**  
Closing the gap between risk estimation and decision-making: efficient management of trade-related invasive species risk
- **Mark Lonsdale:**  
Controlling invasive species through trade agreements: phytosanitary controls
- **Kamaljit Bawa**, R Uma shaanker:  
Utilization of invasives using local skills to enhance local livelihoods : a case study on Lantana camara from South India
- **Llewellyn Foxcroft**, Vojtěch Jarosík, Petr Pysek, David Richardson, Mathieu Rouget:  
The role of boundaries as barriers or pathways of invasion in protected areas
- **Melodie McGeoch**, Dian Spear:  
The CBD 2010 Biodiversity Target: the invasive alien species indicator and national responses

**Symposium S19:****Biodiversity and carbon – towards a research programme to define linkages****Organisers**

- **Guy Midgley**, SANBI, South Africa
- **Pep Canadell**, Global Carbon Project, Australia

**Background and goal**

There are significant overlapping concerns between the global erosion of biodiversity and the stabilization of the human perturbation on the carbon cycle, yet so far they have not been addressed in a synthetic way. Research on the linkages between biodiversity and ecosystem function have advanced over the past few years, at the same time there has been a growing concern of the potential impacts on biodiversity and feedbacks resulting from managing the carbon cycle, both on land and in the ocean. While there is some evidence that a fundamental understanding of the determinants of net primary productivity may be useful in predicting the global distribution of plant species richness, there is little work relating ecosystem species richness at local scales to measures of carbon sequestration and carbon cycling. Greater knowledge of paleodiversity and matching historical changes in global carbon balance can yield new understanding in future shifts in biodiversity in a higher CO<sub>2</sub> atmosphere. Further, increased pressure on the biosphere through the interest in carbon sequestration and bioenergy production requires a better understanding of the function and resilience of productive and natural species ensembles.

We aim through this workshop to begin synthesizing various perspectives in a first step to developing a coherent research programme to define predictive linkages between biodiversity and carbon. We will focus in this session on envisaging how changing CO<sub>2</sub> can act to alter ecological niches.

**Results and discussion**

With key participants we aim to explore the main recent advances in these fields with respect to critical data and models now available to explore linkages, and key questions and research gaps that restrict current understanding. These will result in a perspective-type publication and key ideas for a defined research programme.

**Conclusions**

A new research agenda to further explore the role of biodiversity in the earth system as a contribution to the Earth System Science Partnership and its joint Global Carbon Project.

**Contributors**

- **Ian Woodward:**  
The future for global plant diversity – impacts of changing climate and carbon dioxide concentration
- **William Bond:**  
Biome switches from grassy to wooded ecosystems: conflicts between biodiversity conservation and carbon sequestration
- **Jason Hall-Spencer:**  
The ecosystem effects of ocean acidification due to elevated atmospheric CO<sub>2</sub>

## **Symposium S20:**

### **Ecological and economic impacts of disease emergence through wildlife trade: consequences for biodiversity and public health policies**

#### **Organisers**

- **Katherine Smith**, Brown University, USA, katherine\_smith@brown.edu
- **Conor Kretsch**, Secretariat of the COHAB Initiative, Ireland

In this symposium, we present a novel approach to studying the ecological and economic impacts resulting from an increasing global trade in wildlife carrying potentially harmful diseases. We provide a detailed analysis of the recent trade in wildlife in the USA, which imported >1.48 billion live animals from 2000 through 2006. We present a mechanistic, bioeconomic model of wildlife/EID transport and demonstrate how economic theory can be used to assess risk. We show that there is considerable uncertainty in the benefit to an economy from continued wildlife importation and discuss the circumstances under which a wildlife trade is economically justifiable. We use Avian Influenza H5N1 as a case study to demonstrate the synergistic effects that anthropogenic environmental change (i.e. climate change) and global trade can have on disease spread. We discuss recent advances in our understanding of the ecology of zoonotic diseases with wildlife reservoirs, and the impact of those which have wildlife and livestock hosts. Finally, we consider gaps in awareness, policy and action on the linkages between biodiversity and human health and well-being – with particular focus on wildlife trade. Talks in this symposium will demonstrate how the complexities of disease spread among humans, wildlife and livestock can be best understood by merging medical, social and ecological science.

#### **Contributors**

- **Peter Daszak, Katherine Smith:**  
Conservation, economic and public health impacts of emerging diseases
- **Conor Kretsch:**  
Integrating biodiversity and public health policies
- **Christopher Jerde**, Peter Daszak, David Finnoff, David Lodge, Katherine Smith:  
The parallels of emerging infectious diseases and biological invasions: the biology behind an economic risk model
- **Katherine Smith:**  
Analyzing the wildlife trade as a risk for international disease spread
- **David Finnoff:**  
A bio-economic modelling framework to evaluate the risk of emerging infectious diseases emerging from the global trade in live animals
- **A. Marm Kilpatrick:**  
Avian Influenza H5N1: a case study of disease spread via globalization and environmental change

**Symposium S21:****Linking biodiversity with ecosystem service provision: the role of functional diversity and spatial scale****Organisers**

- **Sandra Díaz**, Cordoba National University – CONICET, Argentina
- **Patricia Balvanera**, Universidad Nacional Autónoma de México, Mexico, pbalvane@oikos.unam.mx

Most researchers now realize that, in order to deepen our understanding of how biodiversity affects ecosystem processes and services, we need to move from traditional approaches based on species richness to other metrics of biodiversity, and from mostly small-scale experiments. Functional biodiversity - the kind, range, and relative abundance of functional traits present in a given community- a metric of biodiversity, is very likely to play a critical role in service provision. Also, incorporation of new analytical tools for explorations at large spatial scales can provide perspectives more directly relevant to management. In this symposium, we will present an overview and update of the latest advancements in concepts, empirical syntheses and methodological tools for the incorporation of functional diversity as well as for the analysis of the links between biodiversity and service provision at larger spatial scales.

**Contributors**

- **Sandra Díaz:**  
From functional diversity to ecosystem processes to ecosystem services: an overview
- **Fabien Quétier**, Francesco De Bello, Sandra Díaz, Karl Grigulis, Sandra Lavorel, T Matthew Robson:  
Incorporating functional diversity into ecosystem service assessments: six steps and many questions
- **Patricia Balvanera**, María José Martínez-Harms, Sandra Quijas, Bernhard Schmid:  
Plant diversity and ecosystem services: moving from small-scale to landscape scales
- **Sandra Lavorel**, Francesco De Bello, Sandra Díaz, Richard Harrington, Jonarthan Storkey:  
Linking organismal traits with ecosystem services across trophic levels
- **David Raffaelli:**  
Biodiversity and services: putting the system back in ecosystem
- **Jens Kattge**, Gerhard Boenisch, Sandra Díaz, Sandra Lavorel, Paul Leadley, Christian Wirth, Colin Prentice:  
TRY: an international initiative for the incorporation of functional traits into large-scale vegetation modelling
- **Fernando Casanoves**, Julio Alejandro Di Rienzo, Laura Pla:  
Novel statistical tools for functional diversity analysis

## Symposium S22:

### Biodiversity science loosely joined: global approaches to taxonomy and biodiversity research supporting science and policy

#### Organisers

- **Simon Tillier**, Museum national d'Histoire naturelle / EDIT, France, tillier@mnhn.fr
- **Hendrik Segers**, Belgian Biodiversity Platform, Belgium
- **David Remsen**, Global Biodiversity Information Facility, Denmark, dremsen@gbif.org

#### Background

By allowing analysis of huge species level data sets, biodiversity informatics enables the modelling of change and engages new research, leading to stronger evidence for policy. Decisive progress is within reach, even though taxonomic knowledge remains incomplete.

#### Goal

The symposium explores the challenges and application of biodiversity informatics and its taxonomic basis, leading ultimately to helping countries achieve sustainable development in line with the UN Millennium Development Goals.

#### Results & discussion

- **Discovery:** grasping megabiodiversity is a real taxonomic challenge, when representation of life has increased far beyond 1.5M species, making it clear that classical taxonomy will never provide the knowledge and data required. However, regarding existing data, thanks to the GBIF network the framework is in place to enable discovery of the full range of biodiversity resources and to place it in the hands of those who can both properly curate it and most effectively utilize it.
- **Access:** taxonomy provides the key to linking all information in the global network to biology. Access to up-to-date, authoritative, and comprehensive taxonomic data provides the basis for accessing the mobilized network of biodiversity information into contexts that make biological sense. Biodiversity informatics opens a new era enabling taxonomists to curate the global web of biological information.
- **Synthesis:** conservation planning and sustainable management of services rendered by ecosystems are improved through modelling, collation and analysis of distributional species level data that may be accessed from a wide range of sources. Some African GBIF nodes such as TanBIF illustrate how the global network provides the means to discover critical data located outside the borders to address critical scientific and policy challenges inside the borders.

#### Conclusion

Taxonomy based innovation opens new avenues for both biodiversity research and policy.

#### Contributors

- **Philippe Bouchet, Simon Tillier:**  
Does size matter? Taxonomic diversity in ecosystems versus representation in biodiversity datasets
- **David Remsen:**  
Creating a virtual library of biodiversity information: the GBIF network
- **Vincent S Smith, David Roberts, Simon D Rycroft:**  
Small pieces loosely joined: towards a unified theory of biodiversity for the web
- **Koen Martens, Estelle Balian, Christian Lévêque, Hendrik Segers:**  
Taxonomy integrated with data analysis: FADA, the Freshwater Animal Diversity Assessment
- **Huw Griffiths:**  
Using large scale biological databases to quantify and interpret key patterns in high latitude biodiversity
- **Flora Ismail, Makabwa Maboko:**  
Mobilising and using biodiversity data beyond borders in Africa: the TanBIF experience

**Symposium S23:****Understanding complexity in African savannahs: people, climate and biodiversity****Organisers**

- **Nicky Allsopp**, South African Environmental Observation Network, South Africa, allsopp@sanbi.org
- **Rob Marchant**, University of York, UK

Impacts of humans on biodiversity rich systems have fuelled debates about the nature of conservation and sustainable life in a populous world. In Africa, savannahs are a major economic resource, but these landscapes have escaped mass faunal extinctions and have a long history of human, animal and ecosystem interaction. What can we learn from African savannahs about ensuring the survival of such landscapes in a changing world?

**We will tackle the complexity of savannahs from three perspectives:**

- **African savannahs: dynamic systems arising from complex interactions.**  
None of the factors influencing savannah structure and function act in isolation. The complexity of these systems will be explored and experiences from several African savannahs will be presented.
- **People in savannahs: promoting coexistence in a changing world.**  
The opportunities and challenges of managing Africa's biodiversity are investigated. Biodiversity underpins livelihoods but habitat transformation, fragmentation and human/animal conflicts are among the threats to this coexistence.
- **Past climates and their implications for people and biodiversity.**  
As more palaeoenvironmental data are produced a coherent perspective on the spatial and temporal character of climate shifts, and how these impact on ecosystems, emerges. Understanding the range of natural variability is essential for sustainable long-term management of savannahs.

Savannahs represent important coupled socioecological systems where natural biodiversity survives at high levels of intactness and human life is supported by many direct and indirect benefits. However, human population growth, climate change and resource use can upset this relationship. This symposium aims to ensure that the heterogeneity inherent at several scales in savannahs, and interdisciplinary approaches, are encompassed in the debate to ensure a sustainable future for African savannahs.

**Contributors**

- **Nicky Allsopp:**  
Introduction
- **Catherine Parr**, William Bond, Emma Gray:  
Biodiversity consequences of a savannah-thicket biome switch
- **Luc Abbadie**, Jean-Christophe Lata:  
Productivity and sustainability of savannahs: how organisms cope with environment?
- **Peter Kofi Kwapong:** The challenge of expanding savannahs on food security and livelihood
- **Luisa Carvalheiro**, John Donaldson, Colleen Seymour, Ruan Veldtman:  
Importance of savannah conservation to maintain ecosystem services supporting agriculture – examples from mango farms in South Africa
- **Karin Holmgren:**  
Historical perspectives of coping with change, with examples from South Africa (Mapungubwe) and Tanzania (Engaruka)
- **Rob Marchant:**  
5 minutes discussion: Savannah ecosystem dynamics: past present and future perspectives
- **Ruan Veldtman:**  
5 minutes discussion: Coexistence of savannahs and people

# Symposiums

**Abbadie Luc**, Jean-Christophe Lata**Productivity and sustainability of savannahs: how organisms cope with environment**

University Pierre and Marie Curie, Paris, Unit Bioemco, France, [abbadie@biologie.ens.fr](mailto:abbadie@biologie.ens.fr)

Symposium S23, Understanding complexity in African savannahs: People, climate and biodiversity

West African humid savannahs are among the most productive terrestrial ecosystems despite strong environmental constraints such as fire, poor soils, heavy rains, etc. This is partly due to the closure of the nutrient cycles, particularly that of nitrogen. Several plant traits and plant-micro-organisms or plant-fauna interactions may explain the savannah high nutrient use efficiency at ecosystem scale. The Andropogonae grasses are the major component of the plant cover. They induce a high degree of nutrient patchiness, which make the nutrient sinks (roots) very close to nutrient sources. This results directly from the tufted structure and the long life span of the dominant grasses. The production of assimilable nutrients is strongly stimulated by the activity of soil fauna that creates very locally better conditions for the microbial mineralization of soil organic matter. Grass roots are able to proliferate in these spots of soil modified by soil fauna. The preferential foraging of nutrient rich patches also seems to be a common strategy of tree roots, which likely decreases the cost of nutrient acquisition. The residence time of nitrogen in the soil plant system is dependent on the chemical form of nitrogen, either ammonium or nitrate. Most savannah grasses are able to strongly decrease the rate of nitrification, which prevents nitrogen leaching and biological denitrification. Savannah grasses are adapted to ammonium nutrition. In conclusion, plant cover structure and dynamic appear as the major drivers of nutrient cycles and soil fertility. Any savannah land use for long term agricultural production should be guided by these natural mechanisms of sustainability and productivity.

**Keywords:** grass, tree, nutrients, nitrogen, sustainability

**Andelman Sandy**, Polasky Steve, Bode Michael**The Cost of Ensuring Global Biodiversity Security Under Climate Change**

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Symposium S01, Climate Change and Biodiversity: Adaptive management in the face of uncertainty

The existing global protected area network represents a substantial investment by societies worldwide to ensure biodiversity security - conservation of biodiversity and the ecosystem services that sustain its human populations - for future generations. Protected areas cover over 11.5% of terrestrial systems and provide protection for 88% of the world's vertebrates and 80% of all threatened species. This investment pattern reflects a static approach to conservation. The key assumption is that habitat loss represents the main threat to biodiversity. Thus, we assume that if an area of land is protected from habitat destruction, the plants and animals living there will persist. Global change challenges this assumption. Evidence is growing that human driven climate change threatens biological systems at both continental and global scales. Given the critical role of protected areas in ensuring biodiversity security, it is essential to understand both the geographic pattern and the magnitude of projected climate change impacts on protected areas and their associated biodiversity. We used data from nine global climate models and two emission scenarios to identify which of the world's protected areas will be most vulnerable to climate change. We found that globally, over half of the world's protected areas are at risk from climate change. Humid tropical forests - containing more than half of the species described on Earth, and storing 80% of the carbon found in terrestrial vegetation - are especially vulnerable. Seventy-seven percent of protected areas in the humid tropics are vulnerable to climate change, and in 27% of tropical forest reserves current climates are projected to disappear entirely. Our research suggests that there is significant risk that the existing global reserve network will fail in its primary objective - to safeguard biodiversity security - unless the world's governments and conservation agencies implement additional policies and climate adapted strategies.

**Keywords:** biodiversity security, protected areas, adaptation, conservation investments, terrestrial ecosystems

**Arroyo Mary****Using georeferenced plant specimen data for detecting macroecological patterns in the South American Andes: searching for a relationship between latitudinal and altitudinal ranges**

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Symposium S13, Mining biodiversity databases: examples for mountain biota and conservation planning

Background and goal of study

Macroecological patterns can be profitably studied in the alpine zone, a replicated, large scale natural experiment that extends over large regions and exists at all latitudes of the globe. The alpine life zone (= above treeline or equivalent) of the South American Andes,

encompassing the páramo, puna, and southern temperate alpine, houses an estimated 6700 species in around 870 genera, and thus is an ideal natural medium for studying macroecological patterns. Using georeferenced species collated from many different herbaria, literature sources and online data bases, the relationship between latitudinal range and altitudinal range was investigated for species of the genus *Senecio* occurring in the páramo and puna of the South American Andes.

### Materials and methods

Latitudinal ranges of species were measured as the number of one degree latitudinal bands and altitudinal ranges depicted as the number of 100 m elevation bands, over which a species is distributed, along an area of the Andes where temperature does not become markedly depressed with latitude.

### Results and discussion

In *Senecio* latitudinal and altitudinal range were found to be positively correlated. The use of georeferenced specimen data is associated with some sticky problems that tend to be swept under the carpet when large data bases are used. Rare species, variation in levels of exploration, the effect of misidentification of closely related allopatric species, and the accuracy of altitudinal ranges obtained from specimens are some of these. The use of some measure of the growing temperature range would be more appropriate than the altitudinal range in this kind of work.

### Conclusion

The pattern uncovered in the genus *Senecio* in high elevation habitats in the South American Andes remains to be tested in other taxa in order to determine whether it is a general macroecological pattern.

Research financed by ICM P05-002 and PBF-23, Chile

**Keywords:** Latitudinal range, Altitudinal range, data bases, georeferences, Andes

### Attwood Colin, Kerwath Sven, Thorstad Eva, Næse Tor, Cowley Paul, Økland Finn, Chris Wilke

#### **Protection of a migratory fish population in a coastal marine protected area**

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Symposium S08, Spatial marine management and new approaches to marine ecology: A way out of the black box?

The application of no-take areas in fisheries remains controversial. Critics argue that no-take areas are only appropriate for resident species. The degree of protection does not depend on the size of the no-take area but rather on the time fish reside inside its boundaries.

We evaluated the potential of a small no-take marine protected area (MPA) inside a coastal embayment as a harvest refuge for a mobile, possibly migratory, long-lived fish species. We used acoustic telemetry to track movements of 30 transmitter-tagged white stumpnose, *Rhabdosargus globiceps*, across and on both sides of the boundary of a small (34 km<sup>2</sup>) no-take area over a full year. Being landlocked on three sides, the location of the MPA inside the lagoon made it practical to detect all boundary crossings and to calculate the MPA-utilisation time for individual fish. We detected frequent movements across the boundary, with strong seasonal and individual variations. There were significant differences in MPA-utilisation patterns between fish from different release areas. The time spent in the MPA by individual fish during summer (mean 50 %; max 98 %) was out of proportion with the size of that area (4 % of total habitat). Summer coincided with peak recreational fishing activity and with the spawning season of this species. The small MPA provides a refuge for a part of the spawning stock of white stumpnose. Our findings suggest that (1) migratory fish may make repeated and prolonged use of small areas and (2) that if strategically placed, a small no-take area can be effective in protecting mobile species.

**Keywords:** acoustic telemetry, fish migration, fish movement, lagoon, marine reserve

### Bachelet Dominique

#### **Bridging the gap – improving science communication to land managers**

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Symposium S01, Climate Change and Biodiversity: Adaptive Management in the Face of Uncertainty

Projecting changes in vegetation cover and structure is important to effectively manage landscapes for resilience to chronic (e.g. increase in growing season length, invasion by exotics) or abrupt changes (extreme events such as floods, stand-replacing fires, insect outbreaks) related to climate change. Several efforts across the United States are underway to include climate-awareness in the decision-making process and incorporate climate change into existing tools used for natural resource planning and landscape assessments. Federal and State

agencies and NGOs (e.g. US Forest service, the Wildlife Conservation Society, the Nature Conservancy, Ecoadapt) are working towards developing approaches that would help overcome the uncertainty paralysis inspired by the lack of confidence in long-term model projections. A series of workshops where climate change scientists, ecologists, wildlife biologists, watershed council members, staff from federal and state agencies, and various other land stewards, have highlighted the need for a common language, simple and effective visualization tools, interactive decision support models, and usable climate impacts information. A few examples will delineate an approach that can help today's land managers prioritize conservation and/or exploitation goals and draw effective plans to maintain ecosystem services (such as high biodiversity) and meet the climate change challenge.

**Keywords:** climate change, forecasts, models, risk assessment, adaptive management

### **Balvanera Patricia, Quijas Sandra, Martínez-Harms María José, Schmid Bernhard**

#### **Plant diversity and ecosystem services: moving from small-scale to landscape scales**

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Symposium S21, Linking biodiversity with ecosystem service provision: the role of functional diversity and spatial scale

#### Background and Goal of Study

Declining biodiversity has negative consequences on ecosystem function, according to recent syntheses. Yet, these have relied upon mostly small-scale experiments designed to analyze ecosystem functioning and not service provision; also ecosystem services are often provided at larger spatial scales. Here we explore the relationship between plant diversity and ecosystem services at a range of spatial scales, using a variety of approaches.

#### **Materials and Methods**

1- We used published databases for local experiments that manipulate plant biodiversity and measure ecosystem function to analyze the effects on ecosystem service provision. 2- We performed an expert survey to inquire about the knowledge on effects of various plant diversity components at various organization levels on the provision of ecosystem services at landscape spatial scales. 3- We mapped the provision of both plant biodiversity and ecosystem services at a watershed scale and explored how they are spatially related.

#### **Results and Discussion**

We found a significant effect of plant diversity on the provision of most ecosystem services at local spatial scales. We found that experts agree about the positive effects of biodiversity on the provision of ecosystem services at landscape spatial scales. The positive effects on species and among communities' diversity, as well as on the number of species, the composition and the structural diversity were emphasized. The spatial patterns of plant biodiversity at a watershed scale only partially matched those of ecosystem service provision. We discuss that plant biodiversity relates to ecosystem services in different ways at the different spatial scales analyzed. Such differences in processes involved need to be clearly acknowledged when providing recommendations to decision makers.

#### **Conclusions**

Plant biodiversity is relevant to ecosystem service provision at different spatial scales. Yet, understanding the nature of such relationship is needed to adequately inform decision makers.

**Keywords:** biodiversity, ecosystem services, spatial scales, plant diversity, landscape

### **Bawa Kamaljit S., Seidler Reinmar**

#### **Progress and potentials of community-based conservation and development in South Asia**

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Symposium S05, Biodiversity Change and Human Well-being

There is considerable debate about the success of community-based integrated conservation and development projects in meeting the twin goals of conservation and poverty reduction. The resolution of this debate concerns a central issue in conservation, namely the effectiveness of community-based management or co-management of biodiversity versus centralized, state-controlled management. An implicit assumption of co-management is that economic incentives for local communities (deriving from limited commercial exploitation of biodiversity) will increase their stake in conservation. Although there have been several evaluations of community based management projects, evidence to support or refute their effectiveness is mixed. Apart from difficulties in measuring poverty reduction and biodiversity conservation, there is a lack of site-specific data on economic and conservation gains as a result of social and economic interventions. We review a number of case studies from South Asia, asking how they compare with the types of programs that may realistically be needed to

stem the ongoing biodiversity crisis in populous industrializing economies. We distinguish and explore five fundamental requirements of such programs: 1) appropriate scaling; 2) priority setting for short, medium and long-term goals; 3) choices and options to realistically accommodate the inherent diversity of people and communities; 4) dispersed governance structures for flexibility; and 5) overall movement toward landscape-level planning. We contrast “threat-based” with “capability-based” approaches to biodiversity protection under rapidly changing conditions and uncertainty. Finally, we suggest possible ways to stimulate the growth of a “conservation & restoration economy” that could eventually satisfy the above requirements, by contributing to genuine economic development and resilience via the protection and rehabilitation of critical natural capital.

**Keywords:** Community-based enterprise, CBNRM, ICDP, capability based approach, conservation economy

**Bawa Kamal**, Uma Shaanker R.

**Utilization of invasives using local skills to enhance local livelihoods : A case study on lantana camara from South India**

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Symposium S18, Globalization and Invasive Species: national responses, international options

Authors: R. Uma Shaanker, Ramesh Kannan, N.A. Aravind, Gladwin Joseph, Bharath Sundaram, Ankila Hiremath, Kamal Bawa

Lantana camara (hereafter, lantana) is native to Central and South America but now occurs in over 60 countries worldwide. It was first introduced to India in 1809, and today is one of the most widespread terrestrial invasive species in the country. We have initiated a unique program to promote the use of lantana as a substitute for the rapidly declining bamboo and rattan resources among some of the poorest rural communities. Encouraging the use of lantana could reduce the demand for bamboo and rattan (cane) by providing alternative raw material for furniture and other value-added products. For such utilization to become an effective management tool -considering its explosive growth potential- its use would have to scale up to industrial proportions. Sustainable utilization can be coupled with restoring biodiversity if local communities have secure access to lantana-invaded forests, and forests are managed for some ‘optimum’ combination of Lantana and biodiversity. - Utilization of Lantana can become a viable livelihood enhancing enterprise when coupled with skilled workers, appropriate value-addition, local institutions, secure access, and diverse and assured market access. On the basis of our work, we have been able to recommend to forest managers evolving a participative management framework to allow for the utilization of invasives coupled with the restoration of local biodiversity. A participative framework would ensure secure access and local decision making facilitated by the state forest department.

**Keywords:** Invasive species, utilization, India, Lantana camara, adaptation

**Bengtsson Jan**

**Biodiversity and resilience: Theory and outcomes in agricultural landscapes**

Swedish University of Agricultural Sciences, Department of Ecology, Sweden, Jan.Bengtsson@ekol.slu.se

Symposium S14, Biodiversity and agricultural sustainability: from assessment to adaptive management

This talk will be divided into three parts:

First, some general theoretical considerations on the possible relationships between biodiversity and resilience in agricultural landscapes will be discussed. The emphasis will be on the important roles of landscape heterogeneity and more diverse farming systems for diversity and resilience in westernized agricultural systems. A combination of metacommunity and biodiversity-multifunctionality theories provides the theoretical background.

Second, I will present recent results from a pan-European study on the effects of agricultural intensification on biodiversity, as indicated by wild plants, carabid beetles, and birds, and the important ecosystem service biological control, the potential of which was measured by exposing aphids to predation in the field.

Third, resilience in agricultural landscapes will be explored. I will consider the roles of landscape structure, local management, farming system and farmers for maintaining farmland biodiversity and how this may contribute to a higher resilience in overall production. Farmers are identified as crucial actors for farmland resilience. Farmer attitudes to nature may be as important as ecological variables for farmland biodiversity. However, landscape factors are often important for biodiversity and ecosystem services such as pollination and biological control. This general finding implies that landscape design and democratic planning processes, on larger scales than individual farms, may be necessary to ensure resilient and sustainable agriculture in the future.

**Keywords:** Diversity, Ecosystem Services, Biological Control, Farmers, Landscape

### **Blignaut James**

#### **PES and human welfare**

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Symposium S04, Creating sustainable multifunctional landscapes: lessons from transdisciplinary programmes

Conceptualizing, planning, and implementing any payment for ecosystem good and services (PES) project involves the direct collaboration of a wide range of academic disciplines. These include economists, hydrologists, ecologists, sociologists and even, in some cases, climatologists. Apart from the range of academic specialists, such a project also requires collaboration from the community or village at the site, an implementing agency, a monitoring and auditing agency, and various government departments at all levels or spheres. A PES project is an exercise in institutional gymnastics.

It should therefore come as no surprise that arguably the biggest stumbling block in starting and implementing a PES project is institutional. Institutional considerations are, among others, the determination of who is the project owner, what would be the common academic language among the scientists, what role would the local village or community play, how would payments be structured would payments be made for the effort or for the product, how are the local benefits in the wake of high transaction costs and expensive scientific time to be maximised. It is this last question that is especially important in a developing country context as it is imperative that a PES project contributes positively to human welfare. Only if a PES project is a viable alternative to the current land use practice from a local resident's perspective such a project could be deemed acceptable.

In this paper I will focus on South African examples where PES have worked, have the potential to work, and where they have failed, due to institutional and welfare concerns and issues.

**Keywords:** Ecosystem Services, Payments for ecosystem goods and services, Biodiversity, Economic Values, Human welfare

### **Bond William**

#### **Biome switches from grassy to wooded ecosystems: conflicts between biodiversity conservation and carbon sequestration**

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Symposium S19, Biodiversity and Carbon – Towards a research programme to define linkages

Background and goal of study

Fire-maintained grasslands and savannahs have the potential to support closed forests with a significant potential for carbon sequestration in extensive areas of the tropics and sub-tropics. Consequently, the management of savannahs for carbon sequestration is being promoted in savannahs in Australia and in parts of Africa, primarily through changes in the fire regime. However, the reduced frequency and intensity of burning can have significant impacts on biodiversity. A reduction in burning has been shown to promote biodiversity so that carbon sequestration and biodiversity conservation can work synergistically. However, this is not the case where grassy biomes are replaced by closed woody vegetation. The spread of forests into grasslands and savannahs has been reported from diverse geographic regions, including parts of South Africa. There is some indication that this biome switch is driven by global drivers (elevated CO<sub>2</sub> ?) in addition to land use change. The goal of this study is to explore these issues in relation to their carbon implications.

#### **Results and discussion**

Examples in South African savannahs show significant carbon sequestration from the conversion of grasslands to woody systems, both below and above-ground. However, the biome switch causes catastrophic changes in plant and insect diversity.

#### **Conclusion**

Conflicts between savannah management for carbon sequestration and biodiversity are likely to increase in those parts of the world vulnerable to biome switches that might be induced by rising atmospheric CO<sub>2</sub> and changing fire regimes.

**Keywords:** Fire, carbon sequestration, biodiversity, disturbance, bush encroachment

### **Bouchet Philippe, Tillier Simon**

#### **Does size matter? Taxonomic diversity in ecosystems vs representation in biodiversity datasets**

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Symposium S22, Biodiversity Science loosely joined: global approaches to taxonomy and biodiversity research supporting science and policy

Large-scale sampling programmes in rainforests and coral reefs reveal that complex ecosystems consist essentially of small, rare and undescribed invertebrate species.

Because it takes considerably more efforts to sample, sort, and identify many small species than to address a few, large, easy-to-identify taxa, this imbalance trickles down to all levels of knowledge on biodiversity. The amount of scientific effort devoted to invertebrates is two orders of magnitude less than that devoted to tetrapod vertebrates and one order of magnitude less than that devoted to plants. Even molecular sequences as surrogates of taxonomic expertise are still a long way from being operational for the swarms of small tropical invertebrates: our results show an almost total incongruence between available GenBank sequences and the mollusc taxonomic diversity curve of a well sampled coral reef habitat. Many species are so rare, seasonal or elusive that they are rarely or never sampled alive, and in this respect, the empty shells of molluscs provide an important – and frightening - window on the “rare biosphere”. After 25 years of intensive exploration in New Caledonia, as many as 73% of all documented turrids – a group of small specialized predatory marine gastropods - are represented only by empty shells, and 34% by a single empty shell.

Before bioinformatics and genomics can help overcome the limitations and bottleneck of “classical” taxonomic expertise, it ironically still requires the skills and knowledge of an expert to actually collect and feed the data on small and rare species into the system. Rather than being disheartened by these difficulties, we see them as an incentive for the biodiversity community to come to grips with mega diverse and taxonomically challenging groups. However, there is a definite risk that biodiversity studies turn a blind eye to 80% of biodiversity, leading in turn to misleading functional analyses of ecosystems.

**Keywords:** taxonomic sampling, ecosystems, diversity analysis, rare species, expertise

### **Brochier Timothée**

#### **Using an evolutionary model of larval dispersal to map small pelagic fish reproduction “hot spots”**

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Symposium S08, Spatial marine management and new approaches to marine ecology: A way out of the black box?

Larval dispersal is known to be a key process for marine populations’ structure and dynamics (Siegel et al., 2008). Larval survival rates (and then recruitment) largely depend on dispersal patterns, which can be seen as an evolutionary selective process acting directly on reproduction success. This process is particularly critical for early life stages, and one can therefore focus on these stages to determine the areas and places for optimal reproductive success in a given environment. While most benthic species are sedentary and have no other choice than to spawn where they are, little is known about the individual-level mechanisms that influence small pelagic fish spawning patterns. However, Mullon et al. (2002) showed that the observed spawning patterns of anchovy in the southern Benguela Current system off South Africa could be accurately reproduced by an evolutionary model of larval dispersal using a natal homing reproductive strategy (i.e. individuals spawning at their natal date and place) and larval mortality as selective constraint. This method also provided promising results when applied to other eastern boundary upwelling systems (Brochier et al., in press). Applications of the method to management problems include: (1) mapping “hot spots” and seasons of successful reproduction, taking into account the large inter-annual variability of the environment, which may be useful to optimize the impact of dates and zones of fishing limitation; and (2) anticipating the effects of climate change on spawning patterns using future climatic scenarios for hydrodynamic forcing of the model. Finally, the evolutionary model of larval dispersal is sufficiently generic to be easily applied to other species than small pelagic fish.

**Keywords:** small palagic fishes, individual-based model, larval dispersion, spawning patterns, evolutionary model

### **Brockington Daniel**

#### **Marketing conservation: Capitalism and neoliberal conservation**

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Symposium S05, Biodiversity Change and Human Well-being

Neoliberal economic practices have dominated global policies over the past twenty five years. In conservation, neoliberal influence is visible in the rise in power and number of conservation NGOs; in the attempts to further conservation goals by selling natural resources managed by community associations; in the use of ecotourism to achieve conservation goals; in the prominence of corporate interests, and the growth of conservation through mitigation. The common result is that conservation is advanced through commodity consumption, or justified in terms of the consumption it makes possible. This paper explores another aspect of neoliberal conservation’s commodity production and consumption – the marketing of conservation images, focusing particularly on the work of celebrity in conservation. Images are important as commodities in themselves and for the commodities and conservation sponsorship they promote. They can create and sustain markets for conservation products and policies. Perhaps their most interesting effects are on audiences. Previous studies of the role of images in society insist that images matter because of the beliefs that they foster – in this case the expectations they create of what places should look like, and how they should be conserved. Where the audiences concerned are wealthy western sponsors the effects

of these images are essential to understand, both in the pressures they introduce on the places they portray, and because of their impacts on the minds of their viewers. When the effects of conservation imagery are taken together with the other aspects of neoliberal conservation I suggest that it no longer makes sense to talk of conservation as saving the world, rather conservation and capitalism are remaking it together.

**Keywords:** conservation, neoliberalism, image, market, celebrity

### **Cardinale Bradley**

#### **What fraction of species do we need to maintain a functioning ecosystem?**

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Symposium S03, The Freshwater Biodiversity Crisis: a global threat to ecosystems and people

While ecologists have historically focused on explaining the causes of biodiversity in nature, a growing body of contemporary research has detailed the ecological consequences of diversity. For example, 150+ experiments performed in the last two decades have manipulated the number of species of bacteria, fungi, plants and animals in ecosystems around the globe to ask how species richness impacts the rates at which organisms capture limiting resources and convert those into biomass. Here I fit data from these studies to several mathematical functions (log, power, and hyperbolic) to derive estimates of the fraction of species that must be conserved to maintain key ecological processes. I begin by showing that the impact of species loss on measured processes is highly non-linear such that, on average, experimental systems require just a tiny fraction (usually < 20%) of the species pool for a community to achieve 95% of the estimated maximal function. However, an important caveat is that most studies have been performed in experimental units that are just a few orders of magnitude larger than the organisms themselves, and the experiments have typically lasted for less than one generation of the focal organisms. When parameter estimates are scaled to account for the spatial and temporal extent of each experiment, estimates suggest that 80% or more of species may be needed to maintain processes within 95% of their maximal values for more realistic ecosystems. Using select examples from the literature, I detail what appears to be a common explanation for these results, which is that small-scale short-duration experiments generally do not permit the expression of niche differences that allow diversity to matter in the first place. These results provide a preliminary estimate of how much diversity may be needed to maintain key ecological processes, and suggest that experiments have tended to over-estimate the apparent level of 'redundancy' among species.

**Keywords:** biodiversity, ecosystem functioning, species redundancy, productivity, niche differentiation

### **Carvalho Luisa, Veldtman Ruan, Seymour Colleen, Donaldson John**

#### **Importance of savannah conservation to maintain ecosystem services supporting agriculture – examples from mango farms in South Africa**

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Symposium S23, Understanding complexity in African savannahs: People, climate and biodiversity

Background and goal of study

African savannahs provide several ecosystem services to the people that live and work within them. Apart from the provisioning of firewood and wild harvested food, services such as pollination and pest control support agricultural production. Lately, the decline of beneficial insects (pollinators and natural enemies of crop pests) in agricultural landscapes is a growing concern worldwide. In South Africa, agricultural intensification is leading to the reduction and fragmentation of savannahs. Here we evaluate how beneficial insect abundance and mango production are affected by the proximity of savannahs; as well as initiate experimental tests on whether sustainable biodiversity farming practices can improve production.

#### **Materials and methods**

To test the importance of flower visitors to mango production we excluded insects from inflorescences and compared seed set between 90 experimental and 90 control inflorescences. We also evaluated how insect communities change with distance to natural savannahs using a food-web approach which includes pest and beneficial insects.

#### **Results and discussion**

Exclusion of flower visitors (mostly Diptera, Formicidae and *Apis mellifera*) leads to a significant decline in mango fruit set. Although the abundances of *A. mellifera* and Formicidae were not significantly affected by the distance to natural habitat, both the abundance of dipteran flower visitors and crop production decline with an increase in distance from natural vegetation.

**Conclusion**

Savannahs are reservoirs of beneficial insects for mango farms, with the presence of these biodiversity-rich habitats near crops leading to higher mango-flower visitation and, consequently, higher yields. Conversely, removal of nearby natural vegetation would reduce the profitability of farming. Conservation of savannahs can therefore increase the sustainability and economic benefits of nearby agriculture dependent on ecosystem services provided by beneficial insects.

**Keywords:** ecosystem services, pollination, beneficial insects, biodiversity, food-web

**Casanoves Fernando, Di Rienzo Julio Alejandro, Pla Laura****Novel statistical tools for functional diversity analysis**

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Symposium S21, Linking biodiversity with ecosystem service provision: the role of functional diversity and spatial scale

Functional diversity defined as the value, range, and abundance of functional traits in a given community or ecosystem (FD) is increasingly accepted as a synthetic ecological concept that sheds light on ecosystem functioning. Several synthetic indices have been proposed to describe the FD of a community, or some of its components. The comparative assessment of FD in different ecosystems and for different ecosystem processes would be an invaluable tool for a better and more general understanding of what are the functional roles of biodiversity in the provision of ecosystem services. However, practical and conceptual difficulties have resulted in the systematic application of these indices to a very small number of case studies. In order to solve this problem we have developed a free-access software package, F-DIVERSITY, which implements a user-friendly interface to open source routines for the estimation and analysis of FD indices. The open source platform is R with an interface written in Delphi®. The software is free and can be downloaded at: [www.fdiversity.nucleodiversus.org](http://www.fdiversity.nucleodiversus.org).

The software can handle its own data sets and read files from different sources. The data handling also allows merging and concatenating different data files into synthetic matrices and tables. The software calculates all the major FD indices. It is also possible to obtain summary statistics, fit sophisticated linear models and make comparisons among communities using different a-posteriori tests. F-Diversity has therefore the potential to become a major tool assisting research on the links between biodiversity, functional traits and ecosystem processes and services. We present and illustrate its main features, as well as discuss some of the properties of some common and new FD indices that can be calculated with it.

**Keywords:** functional diversity indices, convex hull hyper-volume, species abundance, community weighted mean, biodiversity assessments

**Casatti Lilian, Francisco Langeani, Naércio Aquino Menezes, Osvaldo Takeshi Oyakawa &**

Francisco Manoel de Souza Braga

**Parameters to establish priority areas for fresh water biodiversity conservation and restoration**

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Symposium S13, Mining biodiversity databases: examples for mountain biota and conservation planning

Conservation of the São Paulo state freshwater biodiversity was evaluated considering fish as the indicator group, because of broad spatial and specific database availability. After cleaning of the 12,267 original data, a total of 11,691 records of 350 fish species remained. Of these, 61 (18%) were considered target species (endangered, unique records, endemic, with little ability to deal with and/or sensitive to environmental changes). Conservation actions, based on basin scale, were: (i) riparian restoration, (ii) creation of protected areas, and (iii) sampling of little known basins. The definition of where such action would be applied was guided by the proportion of native coverage in each basin; the record of activities that pose threats to biotic integrity maintenance (i.e., sugar cane, urban areas, and hydroelectric dam expansions); the need to protect springs; the existence of a large number of target species; and the biogeographical interest. In nine basins, considered critical, actions to riparian forests restoration should be reinforced, particularly in areas of smooth topography and low availability of surface water. One basin (Alto Tietê) was considered a top priority for the creation of protected areas due to the high occurrence of the target species, the biogeographical relevance, the protection of springs, and the existence of native vegetation remnants. The lack of knowledge is characteristic for regions of increasing pressure for the conversion of natural to urban areas (coastal) or of grassland areas to sugar cane (northwest), areas with a long history of sugar cane cultivation, areas with rising urban speculation (Mantiqueira), and the basaltic Cuesta region, which still preserves a few Cerrado patches in the state. The need for sampling in specific habitats in these regions (i.e. oxbow lakes, swamp areas, marginal and deeper areas of major water bodies, headwaters, and flooded buritizal areas) was emphasized.

**Keywords:** biodiversity, conservation, fresh water, BIOTA, FAPESP, fishes

**Colfer Carol J. Pierce****Action research for catalyzing adaptive management – the critical role of local and decentralized institutions**

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Symposium S15, Research for adaptive management of biodiversity-rich tropical landscape mosaics

Participatory action research (PAR) was planned as a crucial part of the CIFOR-ICRAF Landscape Mosaics project, underway in five countries (Cameroon, Indonesia, Laos, Madagascar, Tanzania) since 2007. The critical role of linkages between local and decentralized institutions was recognized from the beginning, and a central goal of the project was to define common concerns to mobilize social groups to improve the management of landscapes for livelihoods and to maintain/enhance biodiversity. Our intention has been to develop PAR groups in both community subgroups and with district level officials.

The rationale for this approach came from the researchers' recognition that human and natural systems are characterized by complexity and change, varying by context, and consequently there is a need to tailor solutions to local conditions. Another important element has been the search for sustainability after the project's end. Involving important actors at both local and landscape levels is one way to increase the likelihood that activities will continue into the future—both via improved local skills and understanding of local conditions, and in terms of motivation to continue activities that local and landscape level actors select.

This paper briefly reviews our PAR experience on the five sites, highlighting our successes and failures. As with other CIFOR PAR experiences, the balance between research and development remains a complex one for scientists to manage, and the role of on site facilitators is crucially important. Working with decentralized governments and communities has added to the research challenges, as has our attempt to work collaboratively with researchers from other institutes and national governments. We remain convinced that PAR-like approaches are key, yet they must be undertaken with full understanding of the constraints and difficulties.

**Keywords:** PAR, livelihood, landscape, governance, facilitation

**Cowling Richard, Mills Anthony, Sigwela Ayanda, Powell Mike, Marais Christo****Transdisciplinary learning organisations, restoration and carbon**

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Symposium S04, Creating sustainable multifunctional landscapes: lessons from transdisciplinary programmes

Restoration science is served by several conceptual and operational frameworks. These often stress the importance of inter- and transdisciplinarity, learning organizations and adaptive management. But what do these terms actually mean in reality? Here we present conceptual and operational frameworks for restoration science that attempt to place these concepts in a real-world situation – a socially engaged project for mainstreaming and implementing the restoration of degraded rangeland by earning carbon credits. Conceptually, the restoration project achieved interdisciplinarity in that its objectives defined the purpose of research associated with many different disciplines. Furthermore, it resonated with the norms and values of a democratic state that emphasise employment, empowerment and sustainable development, thereby achieving a measure of transdisciplinarity. In operational terms, the project engaged key stakeholders in the governance and implementation spheres from the outset, built a strong biophysical and economic case, and researched institutional opportunities and constraints for implementation. The project is served by two major learning organizations, one for research and the other for implementation. On reflection, the strengths of the project are its solid biophysical and economic assessments, its engagement with key stakeholders, and – most importantly – the existence of a market for carbon credits. Weaknesses include a weak social assessment, the lack of a coherent strategy for implementation, and the failure of the learning organizations to operate effectively. The last-mentioned is a consequence of many factors, especially poor teamwork and conflicting agendas. Under these conditions, adaptive management is difficult. We conclude that the role of dysfunctional organisations in hampering learning in socially engaged projects is widely acknowledged but seldom reported in the primary literature. Ecologists have much to learn from the organizational sciences about creating and sustaining effective learning organizations.

**Keywords:** restoration, carbon credits, interdisciplinarity, transdisciplinarity, learning organizations

**Daszak Peter, Katherine Smith****Conservation, economic and public health impacts of emerging diseases**

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Symposium S20, Ecological and economic impacts of disease emergence through wildlife trade: consequences for biodiversity and public health policies

The emergence of new diseases from wildlife (e.g. HiV/AIDS, SARS, Ebola, H5N1 avian influenza) is a significant threat to public health,

conservation and the global economy. These diseases cause significant mortality (e.g. HIV/AIDS) or act as a significant threat due to the lack of available therapies or vaccines, and their pandemic potential (e.g. H5N1 avian influenza). They are an impediment to wildlife conservation as pressure to eradicate reservoir populations increases (e.g. SARS, plague). Finally, they cause disruption to agriculture and trade, tourism and other key economies – the single outbreak of SARS cost between US \$30 and \$50 Billion and a truly pandemic H5N1 is likely to cost between US\$300 and \$800 Billion. In this talk I will lay out the evidence that a series of anthropogenic environmental and demographic changes underlie the emergence of these diseases. Because many of these factors can be measured and predicted, and their relationships to pathogen transmission can be analyzed, it follows that disease emergence and spread can also be measured and predicted. While the science behind this is in its infancy, I will demonstrate how this approach can be used to provide strategies to prevent disease emergence and spread. This approach may ultimately allow us to identify the likely region of origin of the next unknown zoonosis.

**Keywords:** Emerging infectious diseases, zoonoses, conservation medicine, disease surveillance, public health

**Dauber Jens**, Jane Stout, Mark Emmerson, Erin O'Rourke, Dara Stanley, Rosalyn Thompson, Jesko Zimmermann, Mike Jones

**The impact of bioenergy crop cultivation on temperate biodiversity and ecosystem services**

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Symposium S06, Biofuels and Biodiversity

Background and Goal

Biofuels are promising renewable energy sources which have the potential to reduce both human dependence on fossil fuels and CO<sup>2</sup> emissions while securing future energy supply. The projected primary energy requirements and the renewable energy targets set by many countries require a considerable expansion of bioenergy crop production. Thus, the attempt to mitigate climate change effects might trigger large scale land-use change with undetermined associated effects on biodiversity. The goal of this study is to assess the effects of bioenergy crop production on biodiversity and ecosystem services in temperate regions.

**Methods**

We reviewed studies of the impacts of bioenergy crop production on genetic diversity, species diversity from the field to the landscape scale and on ecosystem services, such as soil carbon sequestration. The focus was on European and North American agricultural landscapes with short rotation coppice, grasses and oilseed rape as the main crop types.

**Results**

Bioenergy crop cultivation was reported to have both positive and negative effects on species diversity and soil properties. Mass flowering crops impact pollination services of wild plants and margins of biomass crops positively affect the abundance of pollinating insects. The direction and the extent of the impact depends strongly on the crop type, the crop management at the field scale, the amount of the crop at the landscape scale, the habitat types that were replaced by energy crops and the respective landscape context. Indirect impacts imposed by the infrastructure and logistics, such as location and size of power plants also need to be taken into account.

**Conclusions**

There is no general positive or negative effect of bioenergy crop cultivation in temperate regions but all potential impacts of a respective crop type, ranging from local to regional scales, need to be addressed in impact assessments of bioenergy crops on biodiversity and ecosystem services.

**Keywords:** bioenergy crops, climate change, fossil fuels, biomass, soil biodiversity

**De Groot Rudolf**

**TEEB: The Economics of Ecosystems and Biodiversity**

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Symposium S04, Creating sustainable multifunctional landscapes: lessons from transdisciplinary programmes

Human well-being depends upon "ecosystem services" provided by nature for free, such as water and air purification, fisheries, timber and nutrient cycling. These are predominantly public goods with no markets and no prices, so their loss often is not detected by our current economic system and can thus continue unabated.

Yet, scientific studies are increasingly demonstrating that, in addition to the dependence of the livelihoods and health of millions of people, the contribution of this Natural Capital to the economy is immense. Likewise the loss of biodiversity leads to enormous costs: with no policy-change estimated to be at least 14 trillion US\$/year (or 7% of the projected global GDP) by 2050.

At the meeting of the environment ministers of the G8 countries in March 2007, the German government proposed a study on 'The economic significance of the global loss of biological diversity' as part of the so-called 'Potsdam Initiative' for biodiversity. Following 'Potsdam', the German Federal Ministry for the Environment and the European Commission, with the support of several other partners, have jointly initiated a global study, named 'The Economics of Ecosystems & Biodiversity (TEEB)'.

TEEB will analyze the global economic benefit of biological diversity, the costs of the loss of biodiversity and the failure to take protective measures versus the costs of effective conservation and sustainable use. TEEB will facilitate the development of cost-effective policy responses, notably by preparing a 'valuation toolkit'.

TEEB Phase I built on the work of the Millennium Ecosystem Assessment and the interim report (2008) proposes a general framework for evaluating the loss of biodiversity and ecosystem services. The second, more substantial, phase of the study will provide more quantitative data and the final results will be presented at CBD COP-10 in 2010.

This presentation will give a brief overview of the TEEB project and interim results.

**Keywords:** Ecosystem, Services, Biodiversity, Values, Economics

### **De Lara Michel, Ocana Eladio, Oliveros-Ramos Ricardo, Tam Jorge**

#### **Sustainable quotas and viable management of ecosystems**

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Symposium S10, Management tools for marine biodiversity

Background and goal of study

We consider sustainable management issues formulated within the framework of control theory. The problem is one of controlling a discrete-time dynamical system (population model) in the presence of state and control constraints, representing conflicting economic and ecological issues for instance.

#### **Materials and methods**

The viability kernel is known to play a basic role for the analysis of such problems and the design of viable control feedback rules. We study the viability of nonlinear generic ecosystem models under preservation and production constraints. Under conditions on the growth rates at the boundary constraints, we provide a rather explicit description of the viability kernel.

#### **Results and discussion**

These conditions lead to define ecosystem sustainable quotas compatible with biological conservation constraints. Numerical illustrations are given for the hake-anchovy couple in the Peruvian ecosystem, with particular emphasis on consistency between ecological and economic conflicting objectives.

**Keywords:** control theory, viability, predator-prey, ecosystem management, quotas

### **Dewi Sonya, Pfund Jean-Laurent, Van Noordwijk Meine, Ekadinata Andree**

#### **Spatial tradeoff analysis of environmental goods and services in forested landscapes**

World Agroforestry Center, Indonesia

Symposium S15, Research for adaptive management of biodiversity-rich tropical landscape mosaics

Most rural landscapes in populated tropical areas are shaped by activities which affect ecological processes through the conversion of the habitat and changes in the movement potential of wild species. Local resource management also affects biodiversity through hunting, harvesting, and management techniques such as selective weeding. In tropical rural landscapes traditional land use practices are often modified or replaced by more intensive management practices. This paper describes spatial patterns of tradeoffs between production, use and conservation in five landscapes, i.e., Bungo (Indonesia), Viengkham (Laos), Manompana (Madagascar), Takamanda Mone (Cameroon) and East Usambara (Tanzania).

The selected landscapes include gradients from protected areas to roads or main cities. We studied the temporal dynamics of land cover and uses as well as spatial variations of biodiversity patches and trade-offs between agriculture, and the use of wild goods and ecosystem services along these gradients. The patterns and locations of the changes are correlated with the drivers and stakeholders, identified through interviews with the local population and stakeholders from the higher landscape levels. According to the different perspectives and governance processes, the article describes who the main stakeholders are and what negotiation platforms and planning processes can be used to plan for more sustainable landscape development along varying conditions.

Livelihoods and ecological processes remain difficult to analyse at a relevant decision making scale. To efficiently inform decentralized governance, there are scientific tradeoffs to accept in order to address the current rapid changes. We propose a validated rapid but holistic approach to analyse trade-offs between goods and services at the landscape level as a decision-support tool. The proposed analyses take into account patterns of land cover, functional landscape indices, hotspots of threats and drivers, tree surveys, semi-quantitative assessment of livelihoods and financial analysis of profitability of land uses.

**Keywords:** Remote sensing, Cost and benefit analysis, Multifunctional landscapes, Landscape patterns, Gradient analysis

## **Díaz Sandra**

### **From functional diversity to ecosystem processes to ecosystem services: an overview**

CONICET, Universidad Nacional de Córdoba, IMBIV, Argentina

Symposium S21, Linking biodiversity with ecosystem service provision: the role of functional diversity and spatial scale

Most researchers now realize that, in order to deepen our understanding of how biodiversity affects ecosystem processes and services, we need to move from traditional approaches based on species richness to other metrics of biodiversity. Functional biodiversity - the kind, range, and relative abundance of functional traits present in a given community - represents a promising approach. An overview of the main conceptual, and methodological developments and challenges in this area will be presented, as an integrative framework for the more specific presentations that will follow in the symposium.

**Keywords:** functional diversity, ecosystem services, functional traits, terrestrial ecosystems, ecosystem functioning

## **Drechsler Martin, Johst Karin, Opdam Paul, Van Teeffelen Astrid, Vos Claire, Wätzold Frank**

### **Opportunities and constraints of tradable permits for biodiversity conservation**

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Symposium S09, Economic instruments for biodiversity conservation and ecosystem services

#### **Background and Goal of Study**

Economic development poses a continuing challenge for biodiversity conservation. In recent years, market-based instruments such as tradable land-use permits have gained increasing attention as flexible instruments to mitigate the conflict between economic development and conservation. We present results from the project EcoTRADE, funded by the European Science Foundation, that investigates the applicability of tradable permits to biodiversity conservation.

#### **Materials and Methods**

The EcoTRADE project performs conceptual analyses, evaluation of existing policies and modelling to gain better understanding of permit markets for conservation. Conceptual analyses reveal the key parameters that determine the functioning and efficiency of a permit market. We evaluate existing policies similar to tradable permits from an economic point of view. Using models, we analyze how spatial habitat connectivity can be influenced by trading rules, how spatial and temporal habitat network properties affect species viability and how trading rules affect the cost-effectiveness of a market.

#### **Selected Results and Conclusions**

Permit markets involve trade-offs. E.g., they must function economically, requiring sufficient market activity, but ecological requirements may restrict trading opportunities. Policies in the US and Germany have shown that permit markets can lead to improvements, both economically and ecologically. Key properties of dynamic networks include the total area of cohesive habitat, its spatial connectivity, the development time and the proportion of network area that changes annually. The ecological model identifies the spatial and temporal constraints of spatially shifting habitat patches across landscapes. The ecological-economic model shows that spatial connectivity can be generated through a permit market, but the cost-effectiveness of a trading rule depends on the properties of the target species and the behaviour of the market participants.

**Keywords:** ecological, economic modelling, global change, market-based instruments, landscape dynamics

**Dudgeon David****Freshwater Biodiversity in the Anthropocene**

The University of Hong Kong, Division of Ecology & Biodiversity, School of Biological Sciences, P.R. China

Symposium S03, The freshwater biodiversity crisis: a global threat to ecosystems and people

Background and goal of the study

Rivers and lakes comprise 40% of the fishes and one third of all vertebrates. As the Anthropocene unfolds, fresh waters are being changed to an extent that threatens the biodiversity they support. Competition among human users for a globally-scarce resource, and the position of fresh waters as receivers within terrestrial landscapes, set the scene for a 'Tragedy of the (freshwater) Commons'. What is the prognosis?

**Materials and methods**

The consequences of climate change, and altered water availability for ecosystems, are reviewed, together with threats posed by pollution, overfishing, dams, and flow modifications. Implications for freshwater biodiversity in the human-dominated landscapes of monsoonal Asia, where extinctions are on-going, will be projected.

**First results and discussion**

Huge water-engineering schemes are among planned adaptations to climate change in Asia; they are certain to put freshwater biodiversity at graver risk. Effective conservation action should be predicated on better knowledge of the biota and their ecological limits, but data generation alone will do little to achieve conservation objectives. A utilitarian approach is required, combining forceful promulgation of what we know about biodiversity with the benefits to be derived from conserving it. Without such advocacy, necessary legislation and policy will not be forthcoming. Knowledge application must be combined with tests of mitigation measures (e.g. e-flows), strategic interventions (e.g. translocations of species threatened by thermal stress), and ex situ conservation (where all else fails) – as well as the economic implications of each.

**Conclusions**

Identification of habitat features that enhance resiliency of the biota will be essential for managing or rehabilitating the fresh waters of the Anthropocene, since the timing, quantity and quality of flows they receive will become governed increasingly by human actions.

**Keywords:** China, Asia, Conservation, Extinction, Climate change

**Dukes Jeffrey****Climate change effects in grasslands: biodiversity and ecosystem services**

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Symposium S17, The role of forest biodiversity for ecosystem processes and services

Changes in climate and the composition of the atmosphere will alter the ecosystem services provided by grasslands through direct effects on the resident species, but also by shifting the competitive balance among the species present in these systems. Warming, elevated CO<sup>2</sup>, and changes in precipitation regimes will favour species with particular traits, and may favour invasive species in some ecosystems. Resulting shifts in species' abundances will not only have consequences for ecosystem services; in some cases, they are likely to threaten native biodiversity.

This presentation will focus on the unknowns: What are the most important predictions we need to make about how grassland biodiversity and ecosystem services may change, and which of these predictions are we least able to make at this time? What needs to be done to improve our ability to predict these responses? Can we identify thresholds and nonlinearities in response based on existing data? Brief illustrative examples will be presented from grassland experiments in California and Massachusetts, USA.

**Keywords:** warming, elevated CO<sup>2</sup>, invasive species, threshold, rangeland

**Duraiappah Anantha Kumar****Equitable access and use of ecosystem services: some insights on governance**

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Symposium S11, Effective governance for ecosystem services: the challenge of matching temporal and spatial scales

Relationships between ecosystem services and the constituents of well-being are context specific and differ across various social groups based on culture, gender, income, social status, geographic location, knowledge (modern and traditional), age, among others.

Furthermore, ecosystems operate, and are measured and observed, at a variety of spatial, temporal and social scales. For example, some

ecosystem services, such as fresh water provision, tend to operate more locally and are observed in shorter time horizons than those which are more regional or global in scale, such as climate regulation. Stakeholders, and their needs, will vary depending on the scale in question. For instance, the stakeholders relevant to managing a transboundary river basin would include national and sub-national government agencies, while those involved in managing a local wetland would be local agencies and community groups. However, in trade-off analyses stakeholder differentiation is seldom acknowledged. Moreover, individual net benefits accruing from ecosystem use options can be significantly different from their social net benefits. Aiming at an increase in aggregate social welfare is insufficient. Equity and fairness should explicitly guide the access to and the use of ecosystem services. The degree of access and use of ecosystem services by individuals and/or social groups is strongly influenced by the institutional climate. This paper aims at analyzing ES governance regimes by comparing several evaluative spaces, mainly income efficiency, distributive justice derived from Rawls; and freedom and capabilities which arises from Sen's breaking ground research. The paper will then explore some core principles for institutions working at various levels such that the equitable access and use of ecosystem services by all relevant stakeholders are not undermined. Finally, the paper will look at institutional design so as to ensure an equitable access and use of ecosystem services or explain the causes of inequitable outcomes across different stakeholders.

**Keywords:** Ecosystem Services, Equity, Evaluative Space, Institutions, Governance

## **Edwards Erika**

### **C4 photosynthesis and climate change**

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Symposium S16, Evolution: the past, present and future of biodiversity

Background and goal of study

C4 photosynthesis refers to a suite of traits that increase photosynthetic efficiency in high temperature environments. Most C4 plants are grasses, which account for ~25% of terrestrial primary production. C4 grasses are largely restricted to tropical and subtropical grasslands, and are replaced by C3 grasses in cooler climates. Particular aspects of C4 physiology have been invoked to explain this C3/C4 temperature sorting. This has been a working premise of biologists for 30+ years, and is also a crucial element of predicting species' shifts in response to climate change. However, it is possible that C4 grasses are simply adapted to warm conditions due to other traits they inherited from their non-C4 ancestors, as C4 origins are clustered in primarily tropical clades.

### **Materials and Methods**

I collated data from two public archives to construct the largest possible grass phylogeny with quantitative climate data for all species. I reconstructed environmental niche evolution across grasses, highlighting divergences in climate between C3 and C4 sister lineages.

### **Results and discussion**

Grasses were ancestrally adapted to hot climates, and C4 evolution was not associated with shifts to warmer environments. However, all C4 origins were correlated with dramatic reductions in precipitation, suggesting that the C4 pathway played a fundamental role in the evolution of drought tolerance. Surprisingly, grasses have rarely invaded colder regions. Innovations associated with cold tolerance may be more important than the C4 pathway in establishing global patterns of grassland composition.

### **Conclusion**

Phylogenies are underutilized tools for understanding why species live where they do. In this case, a phylogenetic perspective provides new concerns about the fate of particular lineages in light of climate change. It also illustrates how standard functional type categories can mask the true functional diversity that drives global ecological patterns.

**Keywords:** C4 grasses, biogeography, climate niche, phylogeny, plant functional types

## **Elmqvist Thomas**

### **Effective governance of urban ecosystem services**

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Symposium S11, Effective governance for ecosystem services: the challenge of matching temporal and spatial scales

Background and Goal of Study

Most ecosystems produce several services and these interact in complex ways. It is often assumed that the maintenance of one service may benefit many others e.g. maintaining soil formation will promote nutrient cycling and primary production, enhance carbon storage and

hence climate regulation, help regulate water flows and water quality and improve most provisioning services, such as food, fibre and other chemicals. However, very little quantification of such synergies has been made and this is also true for an assumed correlation between biodiversity and ecosystem services. How can trade-offs among services be handled and to what extent can new insights in ecology and innovations in institutions and governance help to reduce some of the most undesirable consequences of current trajectories of land use?

### Results and Discussion

History has shown that considering land use and ecosystem services in isolation has frequently resulted in policy failures. Perhaps the best recent example of this is the new European biofuel policy. The European target of 10% of motor fuel derived from biofuel was set as a means of reducing carbon emissions from transport. This is a highly desirable goal, but the consequences have been highly undesirable. The problem is that the policy leads to the management of ecosystems for a single service - the production of biomass for fuel – ignoring the other services, such as carbon storage and trace gas regulation performed by the same or other organisms in the same system.

### Conclusion

In Europe, one challenging option to encourage land use targeted to the delivery of ecosystem service would be a special EU Ecosystem Service Directive, analogous to the existing EU Habitat Directive that delineates the strategy and targets of biodiversity conservation in Europe.

**Keywords:** governance, ecosystems, regulating services, management, biofuel

## Elmqvist Thomas

### **Creating sustainable multifunctional landscapes: lessons from transdisciplinary programmes**

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Symposium S04, Creating sustainable multifunctional landscapes: lessons from transdisciplinary programmes

### Background

To date, research on ecosystem services has focused on valuation and mapping and on tradeoffs between a small set of biodiversity related services. To connect the dynamics of ecosystem services to management action or governance in a changing climate, we need a tool for evaluating tradeoffs among multiple services and analyze to what extent new insights in ecology and innovations in institutions and governance may help to reduce some of the most undesirable consequences of changing climate and land-use.

### Results and discussion

In what ways do the temporal and spatial dynamics of ecosystem change, under climate impacts, challenge existing governance arrangements at multiple levels of societal organization and why do governance systems often fail to protect vital ecosystem functions and resources? Important external factors can include a lack of political interest, administrative fragmentation and inefficiency, and the presence of free-riding behaviour. However, a lack of capacity to understand the behaviour of multiscale ecosystems and their associated services is a fundamental but seldom elaborated factor. At worst, policy-making can unintentionally increase vulnerability to climate change. It is in this context important to distinguish between adaptive capacity - the incremental and frequent adjustments by social actors undertaken more or less daily to deal with change in order to maintain the status quo, i.e. to sustain the current development pathways, and transformative capacity - the ability to fundamentally alter the nature of the system over the long-term, when current ecological, social, or economic conditions become untenable or are undesirable.

### Conclusion

Future research on climate - ecosystem services - governance should focus on an increasing understanding of adaptation processes in a linked social-ecological system and an increasing understanding of how a novel management of ecosystems may facilitate desirable transformations.

**Keywords:** Ecosystem services, Governance, Stakeholders, Natural capital restoration, Trade-offs

## Emmerson Mark, O'gorman Eoin

### **Intact ecosystems are robust to climatic forcing**

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Symposium S08, Spatial marine management and new approaches to marine ecology: A way out of the black box?

**Background**

Food webs provide a framework for considering the importance of primary productivity and predation in structuring communities and ecosystems. If bottom up processes prevail then species populations are likely driven by the physical environment, e.g. productivity or climate, whilst if top down processes prevail then species abundances are more likely to be driven by the presence or absence of predators. Here we consider the consequences of designating Europe's first marine nature reserve, Lough Hyne for bottom up and top-down processes.

**Materials and methods**

Using a 49 year time series of sea urchin (*Paracentrotus lividus*) abundance, spanning the period when the marine reserve was designated, we fitted an Auto Regressive (AR) model including terms for climate (NAO). We explored how changes in the abundance of sea urchins after the designation of the reserve differed from model predictions. We then studied how changes in urchin abundance were driven by increased predator abundance.

**Results and discussion**

We found a strong correlation between urchin population size and the NAO prior to 1981 when the marine reserve was established. After 1981 the climate correlation breaks down. The AR model of urchin population size provides a good fit to the data prior to 1981, and using the model we hind cast the population dynamics of urchins in the marine reserve. We found significant deviations in observed data from the model predictions. We then quantified the abundance of a dominant predator, the velvet swimming crab (*Necora puber*), and demonstrate a trophic cascade in the system that suppresses the climate driven dynamics of sea urchins.

**Conclusion**

Marine protected areas promote the rapid recovery of biomass, the abundance and the trophic structure in harvested systems. We conclude that the restoration of trophic structure protects simplified ecosystems from extreme climate driven dynamics.

**Keywords:** Biodiversity, Food webs, Stability, Trophic cascade, Marine reserve

**Facknath Sunita****Drivers of biodiversity loss in Africa, and social and policy responses**

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Symposium S05, Biodiversity Change and Human Well-being

African biodiversity is linked to food security, either directly (food) or indirectly (environmental goods such as wood/charcoal for cooking, animals for draught power), and also provides medicine, building materials, and spiritual and cultural services. Relatively, Africa's biodiversity is in a better condition. However, of the 119 ecoregions (~ 8% of Africa's total area), 89 have less than 10% of their area under protection.

Anthropogenic causes of biodiversity loss include increasing human population, improved standards of living, changing habits, increasing regional and global trade, agricultural and urban expansion, improper agrochemical use, tourism, introduction of new species/technologies, commercialization of biodiversity, use of GM species, and influx of refugees from war-stricken areas. These lead to land/habitat degradation, desertification, introduction/spread of pests and diseases, resource depletion, climate change, IAS, pollution, erosion, seawater intrusion, and fire.

The link between human populations and biodiversity has always been strong in Africa, e.g. the overlaps between historic cultural centres and biodiversity centres. Factors promoting high biodiversity (a healthy and productive land, water availability, multitude of plant and animal species, etc) also promote human settlement. Correlations are postulated between biodiversity patterns and language diversity, with parallel extinction risks.

Most African countries have adopted a collaborative approach at multiple levels, international, regional and national, e.g. MEAs, international conventions (CBD, UNFCCC, UNCCD, UNCLOS). Africa has a growing number of regional MEAs, complemented by national institutions, technical committees, and biodiversity protection/conservation laws, PPPs, and partnerships with key stakeholders. CSOs are increasingly active in policy-making, and the focus is increasingly shifting to confront social and economic issues.

**Keywords:** Biodiversity loss, Drivers, Social responses, policy responses, Africa

**Finnoff David****A bio-economic modelling framework to evaluate the risk of EIDs emerging from the global trade in live animals**

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Symposium S20, Ecological and economic impacts of disease emergence through wildlife trade: consequences for biodiversity and public health policies

In the second talk discussing Jerde et al.'s evaluation of the net present value, the model is directed at an analysis of policies influencing the trade of live animal imports to the USA intended to prevent potential outbreaks of emerging infectious diseases. Policies of intervention such as regulations over (a) the volume of trade in live animals, and (b) sanitary and phytosanitary (SP) measures taken at either end of the transportation pathways serve to alter the probability of outbreak. Policies are evaluated within the model through comparisons of net present value distributions, which take into account the time and state varying benefits and costs associated with trade, disease incidence, and policies of intervention. The point is that policies of intervention reduce the probability of an outbreak, and reduce the chance of damages, yet are costly themselves and reduce the net benefits of trade. Thus policy-makers face risk-risk tradeoffs that are significantly complicated by the relative rarity of the disease transmission process. Results indicate that the larger the benefits of trade, the greater the outbreak probability society can withstand and expect an outcome with a positive expected net present value. The larger the damages of an outbreak the lower the outbreak probability society can withstand with a positive expected net present value. However, when considering how policies reduce the risk of an outbreak, there are two effects. First, the policy should decrease a transition probability and increase the expected next present value. Second, policies are costly, reduce the benefits of trade and reduce the expected net present value. As a consequence, policy-makers face tradeoffs when evaluating policies to reduce the risk of an EID. The method developed allows policy makers to select policies that reduce the effect of the emergence probability by more than the effect of the costs of the policy.

**Keywords:** Trade, emerging infectious diseases, net present value, uncertainty, rare event

**Fischer Markus****The German biodiversity exploratories as a model for integrated biodiversity monitoring**

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Symposium S07, Analysis and forecasting of biodiversity and ecosystem processes: a contribution to GEO BON

The potential scope of biodiversity monitoring is tremendous. Biodiversity comprises genetic and species diversity of all taxa, interactions among these, and the diversity of ecosystems and landscapes. Biodiversity matters not only in itself, but also because it sustains vital ecosystem services. Usually, however, biodiversity monitoring ignores most of these facets, is limited to few taxa living aboveground, excludes genetic diversity and interactions, and is done independent of the monitoring of ecosystem processes. Moreover, entirely observational monitoring does not identify causal relationships. In the German "Exploratories for large-scale and long-term functional biodiversity research", we are monitoring selected taxa of plants, vertebrates, invertebrates, fungi and microorganisms in forest and grassland plots of different land use intensity. Monitoring of ecosystem processes and manipulative experiments complement observational biodiversity monitoring in numerous plots distributed in three regions of the country. The first two years reveal that diversity of different taxa is not necessarily positively related across plots. This partly reflects that different taxa respond differently to different land use and land use intensity. Moreover, these patterns differed between regions, and so did diversity – production relationships for plants. The Biodiversity Exploratories ([www.biodiversity-exploratories.de](http://www.biodiversity-exploratories.de)) could serve as a model for a future international network for integrated biodiversity monitoring.

**Keywords:** Biodiversity, Ecosystem processes, Land use, Field experiments, Monitoring

**Foster William, Snaddon Jake, Turner Edgar****Do oil palm plantations have to be green deserts?**

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Symposium S14, Biodiversity and agricultural sustains

Oil palm provides one of the best current models for the conflict between agriculture and biodiversity. It is among the world's most extensively grown crops, covering over 13.8 million ha; its range is rapidly expanding now that it is being used as a biofuel; and its cultivation has potentially devastating effects on the high levels of biodiversity and endemism in those tropical regions where it is grown. However, a recent review shows that less than 1% of publications on this crop relate to biodiversity and conservation. This talk will highlight the main findings of current research on oil palm and biodiversity, with especial reference to arthropods, the dominant animal group in this biome. We will discuss the methods that are available for enhancing biodiversity and habitat complexity in oil palm plantations, and how this might impact on the provision of ecosystem services such as pest control. We will explore the collaboration between researchers and industry that will be needed if we are to develop sustainable production of this vital tropical crop.

**Keywords:** agrobiodiversity, oil palm, ecosystem services, arthropods, biological control

**Foxcroft Llewellyn**, Jarošík Vojtěch, Pyšek Petr, Richardson David, Rouget Mathieu

**The role of boundaries as barriers or pathways of invasion in protected areas**

South African National Parks, Conservation Services, South Africa, llewellynf@sanparks.org  
Symposium S18, Globalization and Invasive Species: national responses, international options

**Background and Goal of Study**

Protected areas are becoming increasingly isolated as the landscape is fragmented into a matrix of land use types. However, protected areas remain connected to the surrounding landscape through a complex network of pathways, many of which also act as conduits for the dispersal of alien species. Our aims were to explore the role of the park edge in promoting or preventing plant invasions. We also aimed to explore the extent to which park boundaries act as a buffer (or barrier/filter) for the movement of alien species from outside.

**Materials and Methods**

Using a large, spatially-explicit alien plant distribution dataset (including absence points) from the Kruger National Park, north-eastern South Africa (KNP, ~20 000 ha) we assessed the density of alien plants along the KNP boundary. We added variables from within the KNP, as well as a number of land-use variables from areas adjacent to the park. We first determined the distance from the boundary at which there was a break in alien plant distribution. Thereafter, we determined which factors influence the permeability of the edge, using classification trees.

**Results and Discussion**

The presence of alien species was best predicted by land-use variables in the surroundings of the park, in particular those promoting dispersal such as water courses and roads. Some vegetation types act as efficient filters to penetration of alien plants to the park from the outside landscape.

**Conclusion**

Preliminary results suggest that the edge of the park filters invasions moving into the park. A simple suite of landscape characteristics outside the KNP boundary, and within the KNP appear to predict the presence of alien species. These results should enable predictions to be made of where invasions will occur along the boundary. Such information is crucial for informing integrated management strategies.

**Keywords:** alien plants, biological invasions, conservation, Kruger National Park, non-native

**Georges Jean-Yves**, Fossette Sabrina, Girard Charlotte, Gaspar Philippe, Plot Virginie

**Atlantic leatherback high use areas and hotspots**

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Symposium S08, Spatial marine management and new approaches to marine ecology: A way out of the black box?

Leatherback turtles *Dermochelys coriacea* perform the widest migrations in any sea turtle species, encountering highly diverse environmental conditions worldwide. Leatherbacks are bio-indicators of global ocean's health, since they feed on jellyfish predicted to proliferate with detrimental impacts on marine ecosystems, fish stocks and human activities. Industrial fisheries are however considered as one of the major threats for leatherbacks. To date, there has been no attempt to identify and characterise at the scale of an ocean basin neither the high-use areas where leatherbacks likely feed nor the hotspots where they likely meet fisheries. Here we combine satellite telemetry and stable isotopes to investigate migration patterns and habitat use in 20 leatherbacks captured throughout the Atlantic Ocean (Gabon, Panama, Suriname, French Guiana and Uruguay) in relation to satellite-derived oceanographic data. We show that leatherbacks disperse actively without using any migratory corridor, yet highly impacted by surface currents, to reach highly dynamic oceanographic features where biomass but also fisheries concentrate. We identified 20 high-use areas equally distributed between neritic and oceanic habitats in the Northern, Equatorial and South-western Atlantic and the Gulf of Mexico. Cost-effective stable isotopes confirmed the diversity of migration paths in the northern Atlantic Ocean for 50 more individuals. High-use areas could not be identified using one single oceanographic parameter and were highly dynamic through time and space making their delimitation for conservation issues difficult. This supports the growing evidence that large sample sizes are required for further knowledge and effective conservation.

**Keywords:** marine turtles, tracking, stable isotopes, models, conservation

**Griffiths Huw****Using large scale biological databases to quantify and interpret key patterns in high latitude biodiversity**

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Symposium S22, Biodiversity Science loosely joined: global approaches to taxonomy and biodiversity research supporting science and policy  
The wealth of data in SCAR-MarBIN and the Register of Antarctic Marine Species (RAMS) enables us to quantify, scale and compare Antarctic biodiversity, biogeography, endemism, and taxon ranges between regions within Antarctica and with other well-studied regions of the world.

The SCAR Marine Biodiversity Information Network (SCAR-MarBIN) is the largest repository of distribution data on Southern Ocean (SO) and Antarctic marine life. Understanding the complex ecological and evolutionary information locked within 1,000,000+ records is a great challenge. The analysis of such georeferenced data over the next decade will contribute hugely to science, conservation and ecosystem management.

Data from SCAR-MarBIN have helped to re-draw the biogeographic boundaries of the SO benthos leading to a new understanding of how well connected the SO is and what drives its major distribution patterns. Large-scale comparisons with the Arctic have revealed higher than expected numbers of species shared between both polar oceans. Smaller scale studies have revealed higher species diversity in the South Orkney Islands than in many temperate or tropic archipelagos (e.g. Galapagos). This sort of baseline data can be used to map the latitudinal ranges of organisms and can be used to predict potential changes of distribution due to environmental change.

SCAR-MarBIN represents the most complete view of our knowledge of Antarctic marine biodiversity to date, however it is the analysis of these data that will lead to new understandings of this vast and complex ecosystem and how best to manage and protect it.

**Keywords:** Antarctica, distribution, richness, species range, Southern Ocean

**Gustafsson Lena, Laumonier Yves, Nasi Robert****Reviewed knowledge on plant ecology give guidance on how to integrate biodiversity-concern into tropical forestry in SE Asia**

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Symposium S15, Research for adaptive management of biodiversity-rich tropical landscape mosaics

Sustainably managed tropical forests of SE Asia represent an opportunity for biodiversity preservation but the knowledge on how to integrate conservation aspects into timber production, i.e. the ecosystem approach, is still limited, although there have been recent developments based on the compilation of knowledge on the ecology of the fauna. We have performed a systematic review on the ecology of plants associated with dipterocarp forests, the dominating forest type in the region, to have as a basis for further development of biodiversity-oriented guidelines. Among recommendations derived from the review are i) to maintain a continuous tree cover, ii) to retain biodiversity-important trees (large, with buttresses, knotholes), iii) to set aside a number of specific habitat types of high biodiversity value. We suggest 'authenticity', 'continuity', 'heterogeneity', 'proximity' and 'rarity', to be important conservation principles, and that a multi-scaled approach, separated into the different scale levels of trees, forests and landscapes, should be applied in these tropical moist forests. Main general conclusions are: 1) dipterocarp forests have distinctive characteristics which warrant fine-tuned and specialized conservation models, 2) conservation principles cannot uncritically be transferred from boreal and temperate forests to tropical regions.

**Keywords:** Matrix management, Ecosystem approach, Multi-scaled conservation, Conservation principles, Dipterocarp forests

**Hall-Spencer Jason****The ecosystem effects of ocean acidification due to elevated atmospheric CO<sub>2</sub>**

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Symposium S19, Biodiversity and Carbon – Towards a research programme to define linkages

A novel approach has been undertaken by researchers from the UK, Italy, France and Israel to document the first ecosystem-wide responses to long-term changes in ocean pH. The effects were studied on marine communities around underwater volcanic vents where carbon dioxide bubbles up releasing of millions of litres of CO<sub>2</sub> per day and causing seawater acidification. The major impacts on marine life around the vents included 30% reductions in biodiversity where average pH had dropped by 0.2-0.4 units, (pH 7.8-7.9), compared with areas with normal pH for seawater (pH 8.1-8.2).

This provides the first confirmation of modelling and short-term laboratory experiments which have predicted severe reductions in the

ability of marine organisms to build shells or skeletons from calcium carbonate due to the dramatic effects of CO<sub>2</sub> on seawater chemistry. Although seagrass was tolerant of the increased CO<sub>2</sub> levels, major groups such as corals, sea urchins and calcified algae were removed from the ecosystem and replaced by invasive species of algae.

- . acidification dissolved the shells of calcified species such as corals, sea urchins and snails, which were absent in areas with a pH less than 7.4
- . high CO<sub>2</sub> favoured the production of seagrass
- . the amount of calcified algae, which bind coral reefs together in the tropics, fell from more than 60 per cent cover outside the vent areas to zero within these areas
- . invasive alien species, which cause damage to ecosystems worldwide, were found to thrive at high CO<sub>2</sub> levels

This study demonstrates, for the first time, adverse impacts on marine ecosystems when key groups of species are killed due to rising CO<sub>2</sub> levels and adds urgency to the international policy drive to reduce CO<sub>2</sub> emissions.

**Keywords:** ocean pH, invasive alien species, calcification, biodiversity, biodiversity

## **Hendry Andrew**

### **Humans, evolution, and future of biodiversity**

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Symposium S16, Evolution: the past, present and future of biodiversity

Humans are the world's greatest evolutionary force. We have achieved this dubious distinction through the many ways in which we perturb the environment, thereby altering how selection acts on natural populations. These changes in selection have precipitated evolutionary changes in populations experiencing climate change, trophy hunting, commercial fishing, invasive species, and pollution. In some cases, these evolutionary changes may be important to the persistence of populations facing environmental degradation. Humans can also alter the process of evolutionary diversification itself – we can enhance diversification by creating new niches for species and we can reverse diversification by blurring the distinction between existing niches. For all of these reasons – and more – evolution will be critical in shaping the future of biodiversity in this increasingly human-dominated world.

**Keywords:** rapid evolution, contemporary evolution, adaptation, speciation, conservation

## **Holmgren Karin**

### **Historical perspectives of coping with change, with examples from South Africa (Mapungubwe) and Tanzania (Engaruka)**

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Symposium S23, Understanding complexity in African savannahs: People, climate and biodiversity

African people have vast experience from living in a variable climate and research on past interactions between climate and societies demonstrate the significance of lessons learnt for present situations. Climate change affects human societies differently depending on the societal structure, i.e. including its adaptive capacity and vulnerability. Many societies in the past have shown remarkable resilience to climate change. Common societal adaptations have been spatial and temporal re-configurations of settlements and resource use, as well as the development of new techniques. To include a longer temporal scale, to look into the past in order to learn for the future, is an approach that is becoming more and more emphasized, but there is a great need for further development and testing of methods that combine the earth system, the world system and a historical perspective. A true integration of physical and social data and theory, analysed in a historical perspective, is needed to reach beyond simple deterministic relationships between climate and society and instead advance our understanding of the mechanism behind societal sustainability/vulnerability and ecological sustainability/vulnerability. Such an understanding can provide vital links in the chain that can build sustainable development at local, regional and global levels. Considering the so called vulnerable continent, extended investigations of how African communities cope with and adapt to climatically driven changes is needed to increase the capability to realise the potential as well as the limitations, of modern African communities to adapt to future climate change. Our findings underline the complex interactions between climate/environment and societies that may lead to different developments in time and space.

**Keywords:** climate change, societal structure, interdisciplinarity, historical perspectives, vulnerability

### **Huettmann Falk**

#### **Towards a digital culture for the world's mountains, polar regions and beyond: Supporting adaptive management for a global sustainability**

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Symposium S13, Mining biodiversity databases: examples for mountain biota and conservation planning

#### **Background and goal of study**

Mountain areas and polar regions represent not only major global landscapes, but also unique ecological services that virtually cannot be replaced. The research and subsequent management of these regions should make use of best available science and of internet technology in these times of globalisation. However, despite the progress on global biodiversity databases, mountain areas and many polar regions have been somewhat overlooked when compared with the tropics and the oceans.

#### **Materials and methods**

Here I discuss specific mountain biodiversity as well as Arctic IPY data webportals (GMBA, ArcOD, SCAR-Marbin, IPY) that are linked with GBIF, and that are freely accessible for the global village. Second, I show underlying data flows and applications of webportals dealing with global data sharing, online data delivery, metadata, taxonomies, data mining, modelling and various in-time web services, e.g. Genbank and OpenModeler.

#### **Results and Discussion**

Applications using predictive modelling are shown for how these data can enter various monitoring and management schemes, e.g. GEOSS, and serve as decision-support tools for local, regional and global scales.

**Keywords:** Biodiversity databases, webportal, open access, modelling, decision support tool

### **Irawan Silvia, Tacconi Luca**

#### **Deforestation and ecological fiscal transfers in Indonesia**

The Australian National University, Crawford School of Economics and Government, Australia, silvia.irawan@anu.edu.au

Symposium S09, Economic instruments for biodiversity conservation and ecosystem services

As one of many approaches to climate change mitigation, Reducing Emissions from Deforestation and Degradation (REDD) has been proposed to provide incentives to developing countries to pursue forest conservation. Indonesia's participation in this scheme is crucial due to its contribution to global emissions from deforestation and forest degradation. The government of Indonesia is currently preparing an implementation design to carry out REDD. This contribution discusses national implementation options for the REDD scheme, with emphasis on the distribution of payments through intergovernmental fiscal transfers. For this purpose, it analyzes the existing forest governance and fiscal arrangements in Indonesia.

In Indonesia, the state has control over most of the country's forested land. Local governments are increasingly playing a decision-making role in forest management and land-use change. Forest exploitation and conversion generate revenues for local governments to provide basic public services from local taxes and revenue sharing. Thus, they often perceive forest exploitation and land-use change as one of the easiest ways to generate local public revenues. Intergovernmental fiscal transfers to the local level are suggested as a suitable instrument to provide incentives for local governments and increase their interest in forest protection.

To ensure the successful implementation of REDD, the participation of local governments is suggested to be voluntary. Local governments should be able to assess the costs and benefits of REDD and choose to participate when marginal benefits exceed marginal costs. Following their participation, the distribution of funds generated from REDD could be allocated to the participating regions using existing fiscal instruments such as intergovernmental grants and revenue sharing. Each instrument entails different characteristics related to the distribution formula used. The study addresses the technical feasibility of both instruments.

**Keywords:** Reducing Emissions from Deforestation and Forest Degradation (REDD), Payment Distribution, Decentralized Forest Management, Fiscal Instruments, Forest Conservation

### **Ismail Flora, Maboko Makabwa**

#### **Mobilising and using biodiversity data beyond borders in Africa: the TanBIF experience**

University of Dar es Salaam, Department of Botany, Tanzania, ismailf@udsm.ac.tz

Symposium S22, Biodiversity Science loosely joined: global approaches to taxonomy and biodiversity research supporting science and policy

Biodiversity information is an important tool in development planning as it provides a basis for sustainable development. However, a study

in Tanzania showed that there are unsatisfactory links between those who hold biodiversity data and those who need and use this type of data (development planners, policy makers, or the general public).

Tanzania boasts a vast array of biodiversity as well as Africa's richest and most diverse flora. Biodiversity is an essential source of resources such as food and medicines as well as ecosystem services such as water availability, soil protection, climate regulation, and cultural services including traditional values, research and education. Tanzania's Poverty Reduction Strategy (MKUKUTA) has identified biodiversity as a cross-cutting issue with bearing on poverty reduction. Access to biodiversity data helps address issues such as land-use planning, agricultural pests and diseases, and the spread of invasive species. To improve access to these data and to improve the situation the country decided to create the Tanzania Biodiversity Information Facility (TanBIF).

TanBIF is a National coordinating body established to further technical and scientific efforts to promote the mobilization, sharing and use of biodiversity data and information in Tanzania. Its vision is to make scientific biodiversity data and information the common property of everyone in service to science, economy and public good. It serves to enhance knowledge sharing among scientists, policy and decision-makers and the general public by ensuring that biodiversity data and information is made accessible via the internet through the TanBIF portal. It is also the intention of TanBIF to advance its use for fine-scale analysis of risk analysis for example on diseases spread, protected area management, scientific discovery related to biodiversity and technology advancement required or related to the use or the conservation of biodiversity in Tanzania.

**Keywords:** biodiversity data, development planning, poverty reduction strategy, Africa, GBIF node

## **Ito Motomi**

### **Importance of genetic data in comprehensive assessments of biodiversity**

University of Tokyo, Department of General Systems Studies, Japan

Symposium S07, Analysis and forecasting of biodiversity and ecosystem processes: a contribution to GEO BON

It is well known that biodiversity is hierarchically structured at landscape, ecosystem, species and gene levels. Among them, biodiversity at the gene level, consisting of genetic variation within species and variation of homologous genes among species, is most difficult to be assessed, because it cannot be recognized at one glance, and its assessment requires expensive cost for equipments and chemical reagents needed to obtain molecular information. However, recent progress of biotechnology has made it much easier to obtain biodiversity information at the gene level.

By assessing biodiversity at the gene level, we can often recognize cryptic evolutionary lineages, such as cryptic species or hybrids, which have been neglected by morphological observations. Also, we can document the historical aspect of biodiversity through observations at the gene level; how distantly species pairs are related and how long those have been diverged. This aspect can be quantified as phylogenetic diversity. In addition, we can evaluate the potential utility of biodiversity at the gene level. We have already utilized many organisms as foods, medicine, and so on, but genetic variation may provide us with further value of biodiversity as potential genetic resources.

Here, I introduce several case studies of accessing biodiversity at gene level in East Asia. The first example is the genetic structure of a filmy fern, the *Vandenboschia radicans* complex (Hymenophyllaceae), which has been originated from at least three different diploid species. The other example is *Aster ageratoides* (Asteraceae), which also make a polyploidy complex in East Asia. Also, I will introduce our finding from the hotspot analysis of Japanese ferns based on phylogenetic diversity.

**Keywords:** genetic diversity, molecular information, cryptic lineages, ferns, hot spot

## **Jerde Christopher, Finnoff David, Smith Katherine, Daszak Peter, Lodge David**

### **The parallels of emerging infectious diseases and biological invasions: The biology behind an economic risk model**

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Symposium S20, Ecological and economic impacts of disease emergence through wildlife trade: consequences for biodiversity and public health policies

A byproduct of the global network of human travel and trade is the widespread impacts of biological invasions and emerging infectious diseases. Animals in trade are of particular concern to both of these global, environmental problems. Here we generalize the live animal import pathway and connect the underlying biology to an economic risk model that evaluates the net present value of a simple economy. The net present value is a measure, in today's dollars, of the stream of benefits from live import sales and damages into the future due to biological invasions or emerging infectious diseases. For many impacts, the damages are a low probability, or rare, event. This leads to estimation of the net present value that must necessarily incorporate the uncertainty as to the timing of an invasion or outbreak, and also the

uncertainty in the magnitude of the damages. The resulting distribution of the net present value can be asymmetrical or bimodal, which may lead to poor decision making using established techniques with respect to pre-import screening of invasive species or surveillance of infectious diseases. As an application of the model to invasive species, we consider the threat of Asian carp invasion of the Great Lakes, USA, and the potential loss of North America's largest freshwater fishery. Two pathways of the invasion will be considered, direct passage through the Chicago Sanitary and Ship Canal for which an electric barrier is being operated to prevent the invasion, and through the live import of carps for sale in cities on the coast of the Great Lakes, where some cities are regulating import or sales.

**Keywords:** Biological invasions, emerging infectious diseases, net present value, uncertainty, rare event

## Johnson Steven

### **Plant diversification in southern Africa: can studies of microevolution explain macroevolutionary patterns?**

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Symposium S02, Evolution of biotic diversity in the Southern African winter-rainfall region

#### **Background**

The flora of southern Africa is renowned for its exceptional species richness. As for other regions of the world, macroevolutionary studies have proliferated because of the boom in new phylogenetic information, but have not been reconciled with detailed studies of microevolutionary processes. Thus it remains uncertain whether speciation generally precedes phenotypic diversification of lineages or follows from it.

#### **Approaches**

Using well-sampled southern African lineages, I compare microevolutionary patterns of trait diversification in geographical races with macroevolutionary patterns of trait diversification associated with speciation. The adaptiveness of divergent traits is assessed by means of phenotype-environment correlations, selection experiments and translocation experiments

#### **Results and discussion**

The patterns of divergence among populations comprising geographical races are mirrored exactly by the patterns of divergence among well recognized sister species. Experiments highlight the role of local adaptation in producing these patterns. This is consistent with the view that speciation is simply a phenotypically profound outcome of microevolutionary divergence. Isolating barriers, generally assumed to split lineages, are often just as strong or stronger between geographical races as they are between species, and thus cannot be used to define species, although they obviously explain their coexistence. Phenotypic diversification in southern African plants has been driven by a myriad of ecological factors, including soils, climate and pollinators.

#### **Conclusion**

The results support Darwin's uniformitarian view that ecological races and species fall on the same continuum of outcomes of microevolutionary processes and contradict the Mayrian view of species as special units of evolutionary change. Pollinator-driven microevolution is singled out for its particular value in explaining the famous floral diversification in southern African plants.

**Keywords:** speciation, Darwin, pollination, Flora of southern Africa, ecotype

## Joly Carlos A., Rodrigues Ricardo Ribeiro

### **The BIOTA/FAPESP Program as a successful initiative**

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Symposium S13, Mining biodiversity databases: examples for mountain biota and conservation planning

Since 1999 the BIOTA/FAPESP Program: The Virtual Institute of Biodiversity has been studying the biodiversity of the state of São Paulo, Brazil. The mission of the institute is to inventory and characterize the biodiversity of the State of São Paulo, helping to improve its conservation and sustainable use.

In ten years, with an annual budget of approximately US\$ 2.000.000 the BIOTA/FAPESP Program supported 90 major research projects - which trained successfully 150 MSc and 90 PhD students, produced and stored information about approximately 12.000 species and managed to link and make available data from 35 major biological collections. This effort is summarized in more than 600 articles published, as well as 16 books and 2 Atlas.

In 2001, the program launched an open-access electronic peer-reviewed journal, Biota Neotropica, for original research on biodiversity in the Neotropical region. In five years the journal is becoming an international reference in its area and is already indexed by the Zoological Record, CAB International, EBSCO, DOAJ and SciELO.

Last, but not least, in 2002 the program began a new venture called BIOprospecTA, in order to search for new compounds of economic interest. During 2007/08 the BIOTA/FAPESP researchers, in collaboration with the State of São Paulo Secretary for Environment/SMA and Conservation International, made an extraordinary effort to synthesize its databank in a book and set of 8 maps of biodiversity conservation and restoration priority areas in Sao Paulo state. These maps have just been adopted by the State's Secretaries of Environment, of Agriculture and of Justice as the legal framework for environmental impact assessments. It's a rare example of how a large and well planned research effort can be used to set environmental policies in a highly industrialized State such as São Paulo.

During 2009 the BIOTA/FAPESP Program is organizing a series of events to establish its goals for the next 10 years

**Keywords:** BIOTA, FAPESP Program, Biota Neotropica, BIOprospecTA, biodiversity, conservation

### **Joly Carlos A., Rodrigues Ricardo Ribeiro**

#### **The BIOTA/FAPESP Program: a successful Brazilian experience to use scientific data to improve biodiversity conservation and sustainable use in Sao Paulo State, Brazil.**

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Symposium S07, Analysis and forecasting of biodiversity and ecosystem processes: a contribution to GEO BON

Situated in the SE Brazil, Sao Paulo State (area  $\approx$  250.000 Km<sup>2</sup>) is the most industrialized and urbanized state of the country, has a population of 42 millions, the most complex urban network of Latin America, a GDP of US\$ 450 billion and a per capita income of  $\approx$  US\$ 10.000/year. Cut by the Tropic of Capricorn, Sao Paulo is the southern limit of Cerrado Savannah; the northern limit of Araucaria forest; has a large forest-savannah ecotone; a heterogeneous relief with sierras, plains and large river basins, as well as 720 Km of coast. Therefore, whatever the vertebrate group considered, Sao Paulo has extremely high number of species. The same is true for Angiosperms.

Nevertheless, most of its native vegetation has been replaced by coffee in 1800 and later on by cattle ranching, Eucalyptus plantation, orange and, since ethanol began to be used to run cars, by sugarcane. Therefore, apart from the large remnants of Atlantic Rain Forest that still covers the Sierra do Mar Complex, there is less than 2% of native vegetation left, in a highly fragmented landscape.

In this scenario we started the BIOTA/FAPESP Program in 1999, as a research program to inventory, map and characterize the biodiversity of the State, helping to improve mechanisms for its conservation and sustainable use. In 10 years, the Program supported 90 research projects, producing and storing information about 12.000 species, and managed to link and make available data from 35 major biological collections.

This effort allowed the use of 62,600 registers of 5,463 species of plants, 1,815 & 433 spp Cryptogams, 8,062 & 150 spp Mammals, 19,742 & 520 spp Birds, 431 & 74 spp Reptile, 15,351 & 168 spp Amphibians, 11,620 & 349 spp Fishes, in combination with landscape structural parameters and biological indexes, to establish priority areas not only for conservation but also for restoration. These maps were officially adopted by the State's government as the legal framework for biodiversity conservation.

**Keywords:** BIOTA, FAPESP Program, [www.biota.org.br](http://www.biota.org.br), Neotropical biodiversity, Biodiversity Conservation, Biodiversity Restoration

### **Judith Kruger**

#### **Analysing biodiversity monitoring data: Are we succeeding in analysing data in time to enable us to apply Adaptive Management principles successfully?**

SANParks, South Africa

Symposium S15, Research for adaptive management of biodiversity-rich tropical landscape mosaics

South African National Parks (SANParks) has actively been using strategic Adaptive Management (SAM) for more than a decade. SANParks has added a step of setting Thresholds of Potential Concern (TPC's) for selected environment variables into the conventional SAM structure. These selected variables are monitored and the results are then fed back to determine whether the TPC has been exceeded and whether the objectives that were set in the beginning have been met or not. For each variable that is measured data is collected and this data is analysed to determine whether the TPC has been reached or not. Depending on how quickly and accurately this data is analysed and the results fed back into the system will determine how effectively the SAM approach can be implemented. This talk will look at factors that affect the SAM process focusing on TPC setting, developing monitoring programs, analysing the data and present some automated approaches that will help us analyse data timeously. Examples will be used from current TPC and monitoring programs operational in SANParks which will illustrate where data is not analysed timeously and where it is and the effects that both of these have on the success of Adaptive Management

**Keywords:** Adaptive management, analysing data, TPC, monitoring, biodiversity

**Juergens Norbert****Standardised biodiversity monitoring within the BIOTA AFRICA network – lessons learnt after 8 years of standardised biodiversity monitoring.**

University of Hamburg, Biocentre Klein Flottbek, Germany

Symposium S07, Analysis and forecasting of biodiversity and ecosystem processes: a contribution to GEO BON

**Background and goal**

The BIOTA AFRICA observation system aims at combining various scales and goals within one integrative concept.

**Materials and methods**

Remote sensing data, biogeographical data and ground truth information on biodiversity dynamics within an ecosystem context form the core components. Thereby, biodiversity dynamics at the ecosystem, species, population, individual and genomic levels are accessible. In addition, essential environmental information is monitored. Standardised scales and methodologies improve comparability of measures, trends and processes. In addition, experiments generate information on ecosystem processes and mechanisms, while the evaluation of a range of archives adds information of the history of past changes of land use and vegetation.

**Results and discussion**

Thanks to these characteristics, the BIOTA observation system forms a large-scale contribution to the global effort to establish a Global Biodiversity Observation System (GEO BON) within the frame of the DIVERSITAS bioDISCOVERY core project and GEOSS.

**Conclusions**

Based on 8 years of observation this presentation summarises strength and weaknesses of the approach and provides a number of recommendations for future observation of change of biodiversity and ecosystem processes in real landscapes.

**Keywords:** GEOSS, GEO BON, Africa, Monitoring, Ecosystem processes

**Katongo Cyprian****Evolutionary Biology of Freshwater Fishes of Africa**

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Symposium S12, Genetic drivers of freshwater biodiversity

**Background and goal of study**

The haplochromine cichlid group of fishes was used as a model to explain the origin, speciation and spread of African freshwater fishes, because they belong to one of the major cichlid lineages represented both in Lake Tanganyika (an ancient lake) and in the rivers and lakes of sub-Saharan Africa. This study involved the use of genetic methods to explain the phylogeography of African freshwater fishes.

**Materials and methods**

Representative cichlid fish samples collected over a period of 10 years from sub-Saharan Africa were preserved in formalin (whole fish specimens) and in ethanol (fin clips). The taxonomy of the fish species followed the CLOFFA system. Molecular techniques entailed mitochondrial DNA (mtDNA) extraction and sequencing followed by phylogenetic reconstruction.

**Results and discussion:**

The phylogenetic trees revealed that the haplochromine cichlids originated in Lake Tanganyika and then seeded and radiated in Lakes Malawi, Kivu, Victoria, Turkana, as well as the now extinct paleo-Lake Makgadikgadi within a short period of time. The haplochromine cichlids show a highly complex phylogeographic pattern, most likely influenced by climatic changes and geological processes, with river capture events most likely playing an important role for species dispersal.

**Conclusion**

The drivers of the diversity of African freshwater haplochromine are both genetic and environmental and may be similar for the tilapia cichlids and the non-cichlid freshwater fishes of Africa.

**Keywords:** freshwater, haplochromines, mtDNA, phylogenetic, speciation

**Kattge Jens**, Gerhard Boenisch, Sandra Díaz, Sandra Lavorel, Paul Leadley, Christian Wirth, Colin Prentice

**TRY: an international initiative for the incorporation of functional traits into large-scale vegetation modeling**

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Symposium S21, Linking biodiversity with ecosystem service provision: the role of functional diversity and spatial scale

TRY is a new collective effort to compile information on ecological traits of plant species at global scale. It is a novel approach towards a communal data repository: hosting data in one central database while the data ownership still belongs to data providers. Two strands of research can be seen as having led up to this initiative: research to understand the dimensions of ecological strategy variation across plants and research to model vegetation-climate-biogeochemistry large-scale interactions at the broad scale. We focus on the relations of plant trait data to global vegetation models not only because of the immediate aim of improving parameterization and thus understanding of the effects of climate change. More broadly these models provide a helpful testing ground for much of what we know about plant ecology. These models express, at the moment, our best judgment about which plant traits are both influential for ecosystem outcomes and also understood in a sufficiently quantitative way to be incorporated into models. The TRY database currently contains more than 2.2 million trait entries with a focus on 47 key traits. Due to its high number of entries, it allows for the first time data-based accounting of functional biodiversity within global vegetation models beyond the specification of few plant functional types. We will show some of the TRY first applications, contrasting the current parameterization of vegetation models with the observed trait variation across species, and demonstrating the enhanced potential to characterize the interplay between ecological strategy dimensions and physical environment. Apart from the high coverage in space, climate and phylogeny, the effort to compile traits at a global scale also reveals serious deficiencies with respect to the coverage of some traits and ancillary information, including local soil and geomorphological information.

**Keywords:** plant functional ecology, biodiversity, biogeochemistry, biogeography, large-scale vegetation modeling

**Keller Michael**, Stohlgren Thomas J.

**The U.S. National Ecological Observatory Network (NEON): An infrastructure to enable analysis and forecasting of biodiversity and ecosystem processes at a national scale**

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Symposium S07, Analysis and forecasting of biodiversity and ecosystem processes: a contribution to GEO BON

The National Ecological Observatory Network (NEON) is a national-scale research platform for understanding the impacts of climate change, land-use change, and invasive species on ecology. NEON is currently in its design phase under sponsorship from the U.S. National Science Foundation (NSF). NEON will gather long-term data on ecological responses changes in land use and climate, and on feedbacks with the geosphere, hydrosphere, and atmosphere. NEON concentrates intensive data collection of a large suite of variables at a relatively small number of sites (60) to link forcings and responses in ecological systems. This design sets NEON apart from most existing biological monitoring networks.

NEON will consist of distributed sensor networks and experiments, linked by advanced cyberinfrastructure to record and archive ecological data and samples of organisms and substrates (litter, soil, and water) for at least 30 years. Biological observations in NEON will cover a wide range of areas including biodiversity sampling for selected taxa (plants, small mammals, some insect groups, etc.), population dynamics for those groups, productivity, phenology, infectious disease, biogeochemistry, microbial diversity and function, and ecohydrology. Using standardized protocols and an open data policy, NEON will gather essential data for developing scientific understanding and theory that address basic questions in biology and issues relevant to ecosystem management. Data collection and analysis will lead to data products that enable forecasting of the future states of ecosystems through open access community models.

NEON observations will be made over 20 domains defined using a rigorous statistical geographic clustering algorithm based on eco-climatic data. For each domain one candidate core wildland site has been identified based on its representativeness within the domain. These long-term sites will be supplemented by relocatable sites that focus on the dynamics of land use.

**Keywords:** NEON, forecasting, biodiversity, ecosystem, infrastructure

**Kilpatrick A. Marm****Avian Influenza H5N1: a case study of disease spread via globalization and environmental change**

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Symposium S20, Ecological and economic impacts of disease emergence through wildlife trade: consequences for biodiversity and public health policies

The spread of highly pathogenic H5N1 avian influenza into Asia, Europe and Africa has resulted in enormous impacts on the poultry industry and presents an important threat to human health. The pathways by which the virus has and will spread between countries have been debated extensively. By integrating data on phylogenetic relationships of virus isolates, migratory bird movements, and trade in poultry and wild birds we show that it is possible to determine the pathway for individual introduction events into countries and to predict future spread. Patterns of transmission and spread of H5N1 highlights the synergism between trade and wild animal movement in the emergence and pandemic spread of pathogens, and the role of environmental change in transmission of this pathogen. Our analyses predict that H5N1 is more likely to be introduced into the Western Hemisphere through infected poultry and into the mainland USA by subsequent movement of migrating birds from neighbouring countries, rather than from eastern Siberia.

**Keywords:** disease, trade, globalization, bird migration, virus**Kinabo Joyce****Do social and cultural responses to biodiversity loss benefit the poor?**

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Symposium S05, Biodiversity Change and Human Well-being

Biodiversity is a measure of the number and variability of living organisms in an ecosystem. Biodiversity contributes both directly and indirectly to many constituents of human well-being, including security, basic material for good life (food, water, etc), health, good social relations, and freedom of choice and action. However, the interaction between human and the ecosystem may transform the ecosystem and invariably lead to reversible and irreversible changes in the ecosystem and loss of biodiversity. Biodiversity loss has negative effects on human well-being, with increase in human population, economic, social and technological activities have also increased. Thus, the loss of biodiversity and the associated changes in ecosystems have accelerated, posing a significant threat to human well-being. Many communities at various levels have developed a variety of responses to manage the consequences of their changed interactions with ecosystems. The responses have ranged from economic, legal, technological, social and cultural changes to changes in cognition and behaviour. These responses have had impacts on the ecosystem (some bad and some good) and have affected different communities and different levels of the same communities differently. This paper attempts to examine the use of the social and cultural responses in managing biodiversity loss. It further attempts to examine the consequences of the social and cultural responses to human well-being and answers the question whether the responses benefit the poor and proposes alternative responses.

**Keywords:** Biodiversity loss, responses, social, consequences, poor**Koerner Christian****Forest and grassland diversity controls ecosystem responses to a CO<sub>2</sub> rich future**

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Symposium S17, The role of forest biodiversity for ecosystem processes and services

**Background and goal of study**

For mostly unknown reasons, species differ in their growth responses to elevated CO<sub>2</sub>, with some gaining, some losing and some unaffected. In natural vegetation the short-term net-result is often zero. However, gradual species replacement may exert long-term ecosystem consequences. Very unfortunate for modelling, a priori defined plant functional types do not show uniform responses. In graminoids, Cyperaceae are more responsive than Poaceae, in legumes and trees responses are completely species/site specific. There is a trend, for more mesic taxa to take advantage, possibly related to CO<sub>2</sub>-driven soil moisture savings, most effective under moderately dry, but not at moist or very dry conditions.

**Results and discussion**

These trends are illustrated for alpine, temperate lowland and semi-arid grassland and for temperate montane and lowland as well as tropical forests. The responses reflect species x soil x CO<sub>2</sub> interactions, where soil may come in through either moisture, pH or nutrient availability. A critical interaction is that between CO<sub>2</sub> and light, which appears to favour lianas during their early growth stage in deep shade, both in temperate as well as tropical forests, causing them to more likely reach the canopy and thereby enhance forest dynamics.

### Conclusion

A relative stimulation of moisture demanding taxa by elevated CO<sub>2</sub> will cause ecosystems to become more vulnerable to extreme drought. Given that the outcome of species succession will determine the ultimate ecosystem response to elevated CO<sub>2</sub>, we need to explore species specific responses under as natural as possible experimental conditions. At current knowledge for natural systems, water driven (indirect) CO<sub>2</sub> effects seem to exceed photosynthesis driven (direct) effects, which urges a shift in modeling priorities.

**Keywords:** elevated CO<sub>2</sub>, plant functional types, biodiversity, water, nutrients

### Kretsch Conor

#### **Integrating biodiversity and public health policies**

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Symposium S20, Ecological and economic impacts of disease emergence through wildlife trade: consequences for biodiversity and public health policies

The COHAB Initiative (Co-operation on Health and Biodiversity) is an international project established to respond to the gaps in awareness, policy and action on the links between biodiversity and human health. The Initiative acts as a global framework to support activities in international development, biodiversity conservation and population health, including implementation of the U.N. Convention on Biological Diversity, and realising the U.N. Millennium Development Goals. By creating a forum for experience sharing, collaboration and networking, the Initiative has developed a broad partnership base of scientists, government ministries, community representatives, IGOs and NGOs. Through direct contacts with stakeholders, COHAB targets key factors affecting the success of transdisciplinary approaches at the policy level (1. the method of communicating the issues, 2. availability of resources, 3. political and civic engagement), and has developed a simple framework for addressing some complex problems. The COHAB approach targets specific strengths and weaknesses within existing policies and programmes, and uses existing strategic tools to foster a systemic approach to health and biodiversity conservation. At the institutional level, COHAB has had success in tackling various conceptual barriers, particularly amongst health practitioners and policy makers. However, surprisingly, communicating the health relevance of biodiversity to people working in biodiversity science and policy, and involving them with other sectors, remains difficult. Other challenges include connecting with the private sector and bilateral aid and funding agencies which influence policy development and implementation. This paper provides an overview of the COHAB approach, from initial partnerships with the Government of Ireland and the CBD Secretariat, to current dialogue with indigenous communities and the Initiative's strategy towards the 20th anniversary of the Rio Earth Summit in 2012.

**Keywords:** health, ecosystems, COHAB Initiative, transdisciplinarity, MDGs

### Kuhlmann Michael

#### **Bee diversity in the winter rainfall area**

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Symposium S02, Evolution of biotic diversity in the Southern African winter-rainfall region

#### **Background and Goal of Study**

Bees are the most important pollinators of flowering plants. They are believed to play an important role in plant speciation especially in the Cape Floral Kingdom (CFK). The CFK is the only place globally where a centre of bee diversity coincides with a plant diversity hotspot. Biogeographical patterns of bees can help to provide insight into evolutionary processes leading to speciation and foster studies on plant-pollinator interactions. Here the biogeography of the southern African bee fauna is analysed with special emphasis on South Africa and particularly the CFK. The main goals are: 1. to estimate the scale of bee diversity and endemism; 2. to identify and describe distribution patterns; 3. to discuss these patterns in relation to those shown by flowering plants as the principal food source.

#### **Materials and Methods**

Patterns of southern African bee diversity and endemism were studied based on records of 645 species and analysed on a 2° x 2° grid. For South Africa distribution patterns of 516 species were investigated.

#### **Results and Discussion**

Bee diversity in southern Africa shows a bicentric pattern, with highest species diversity located in the arid west and in the relatively moist east. Twelve distribution types were identified that largely coincide with patterns in the seasonality of precipitation. The largest number of bee species (46.3%) is associated with the winter rainfall area and the early to mid summer rainfall area (36.5%) respectively. The most

important centres of endemism are the winter rainfall area in the west (27.3% of total fauna endemic) and the early to mid summer rainfall area (29.1% of total fauna endemic) in the east.

The relationship between bee and plant diversity patterns and speciation is discussed. Based on additional data a hypothesis of potential processes facilitating speciation in both groups is outlined.

**Keywords:** bees, pollinators, diversity, endemism, South Africa

### **Kumar Surender, Managi Shunsuke**

#### **Compensation for environmental services and intergovernmental fiscal transfers in India**

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Symposium S09, Economic instruments for biodiversity conservation and ecosystem services

Compensation for environmental services helps in internalizing the environmental externalities through the transfer of financial resources from beneficiaries of certain environmental services to those who provide these services. Decentralized governments perform several ecological functions and intergovernmental fiscal transfers are a suitable mechanism for compensating these governments for their ecological public functions.

Despite having a plethora of conservation related programs and activities, the condition of natural resources is degrading in India. However, the prevailing intergovernmental fiscal transfer mechanism in India provides neither incentives for conserving natural resources nor disincentives for frittering them away by the sub-national governments. Though socio-economic indicators as criteria for fiscal devolution have long been an integral part of the inter-governmental fiscal transfers, the functions related to ecological services are still largely absent in the country.

We discuss mechanisms to compensate local governments for the public provision of environmental services using the theory of optimal fiscal transfers. Depending on the type of activities, there is need for both, lump-sum and earmarked grants for internalizing the ecological spillover effects. An illustration of inclusion of forest cover in the devolution formula for distributing lump-sum fiscal transfers demonstrates that it not only compensates the regional governments for their ecological public functions but also helps in addressing the problems of regional inequality and poverty.

**Keywords:** Environmental services, fiscal federalism, spatial externalities, environmental expenditure, India

### **Kwapong Peter Kofi**

#### **The Challenge of expanding savannahs on food security and livelihood**

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Symposium S23, Understanding complexity in African savannahs: People, climate and biodiversity

#### **Background and Goal of Study**

The protracted food crisis in tropical Africa has been compounded by the impacts of expanding savannah landscapes as a result of human actions. Savannahs have been characterised by low biodiversity and poor soils which are exposed to droughts and floods, further threatening food security and human livelihoods. Key issues have to do with human efforts at deliberate setting of fires for hunting, as well as bush clearing and burning to make way for fresh vegetation to feed livestock. The focus here, however, is the importance of bee pollinators as a determinant to food security and human livelihood.

#### **Materials and Methods**

An impact assessment of the increasing savannahs on crop production and bee pollinators was done to investigate possible additional threats to the food security of resident communities.

#### **Results and Discussion**

The assessment showed that human interferences have negatively affected the habitats and forage resources of crop pollinators. Resource use by humans and their livestock have left bees to struggle for water, forage and suitable habitats, resulting in declines. In turn, bee pollinator declines lead to inadequate crop pollination and subsequent low yields, thus rendering dependent local communities very poor and unable to support livelihoods.

**Conclusion**

A policy environment to educate and support smallholder farmers could help transform savannah agricultural lands into productive and sustainable rich soils. Small holder farming communities could be empowered to sustainably manage landscapes in ways that will simultaneously improve food security and biodiversity conservation within savannah areas.

**Keywords:** Savannahs, Food security, Bee pollinators, livelihoods, policy environment

**Lavorel Sandra**, Harrington Richard, Storkey Jonathan, De Bello Francesco, Diaz Sandra

**Linking organismal traits with ecosystem services across trophic levels**

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Symposium S21, Linking biodiversity with ecosystem service provision: the role of functional diversity and spatial scale

**Background and Goal of Study**

Many ecosystem services, such as maintenance of soil fertility, pollination, or water purification depend on processes involving several trophic levels. Previous studies have identified the role of functional traits of organisms in processes at single trophic levels, but a conceptual framework linking these across interacting trophic levels to predict the response of ecosystem services to environmental change is lacking.

**Materials and Methods**

Such a new framework is based on the Holy Grail hypothesis, which identifies linkages between plant responses to environment and effects on ecosystem functioning via shared, functionally or phylogenetically correlated functional traits. The framework operates by identifying such linkages across four sets of traits: functional effect traits on processes underlying ecosystem services, trophic effect traits affecting adjacent trophic levels through biotic interactions, trophic response traits determining response to these biotic interactions, and environmental pressure response traits.

**Results and Discussion**

We demonstrate the wide applicability of the framework using three examples in agroecosystems. Decreases in pollination following grassland management intensification result from the loss of legumes, whose floral traits favour more functionally diverse bee communities. Maintenance of fertility by moderate grazing relies on linkages between plant, nitrifying and denitrifying soil microbial traits. Finally, field margin management can favour those plant traits that influence the functional diversity of invertebrates providing multiple services including weed population control, biocontrol of crop natural enemies, and enjoyment of the countryside.

**Conclusion(s)**

This framework will advance fundamental understanding of complex biotic dynamics underlying ecosystem service provision. It will facilitate quantitative assessments of the effects of environmental change on ecosystem services.

**Keywords:** ecosystem services, environmental change, functional traits, biotic interactions, multi-trophic communities

**Leadley Paul****Climate change and Biodiversity: addressing the issues of uncertainty and costs in adaptive management**

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Symposium S01, Climate Change and Biodiversity: Adaptive Management in the Face of Uncertainty

The potential impacts of climate change on biodiversity are pushing scientists, natural resource managers and policy makers to rethink conservation strategies. In particular, projected large scale changes in the spatial distribution of species call into question the substantial investments that have been made in protected areas, water resource management, etc. that were developed to conserve biodiversity in a world where species ranges were assumed to be static. But climate change is likely to make the future very dynamic, because model projections, observations of recent changes in species ranges and the paleological record all indicate that species ranges have and will continue to move large distances due to climate change. Many studies have started to examine the impact on conservation strategies in the light of climate change; however, two key issues have received relatively little attention in discussions of climate change impacts on biodiversity: 1) quantifying the uncertainties in projecting future changes in biodiversity and 2) quantifying the economic costs of climate change impacts on conservation of biodiversity and associated ecosystem services. These issues raise several important and largely unanswered questions:

What is the level of uncertainty in projections of climate change impacts on biodiversity? How should uncertainty be taken into account

when developing management strategies in the face of climate change?

Should conservation strategies focus on increasing resilience of species or ecosystems to climate change or should they facilitate transitions?

What will be the costs of the reduced effectiveness of current conservation strategies due to climate change?

How much will it cost to create conservation strategies that provide adequate protection of biodiversity and ecosystem services in the face of climate change?

This talk provides an overview of these issues and introduces a series of symposium talks using case studies to provide preliminary responses.

**Keywords:** Climate change, biodiversity, conservation, scenarios, protected areas

## **Leemans Rik**

### **The myths of using forest for biofuels: Flawed promises risk biodiversity, climate and sustainability**

Wageningen University, Environmental Systems Analysis Group, The Netherlands

Symposium S06, Biofuels and Biodiversity

To slow the increase in atmospheric CO<sub>2</sub> concentrations, increasing use of biofuels for transportation have been proposed. Many oil crops can directly be used to produce bio-diesel and starch and sugar can be converted into ethanol. More recently, other plant components (e.g. cellulose) or algae harvesting systems have been suggested to increase the effectiveness of biofuel production. Over the last decades many studies have assessed the potential of different crops and processes to produce these fuels. One of the major limitations of biofuels crops is that they require land and thus compete with other land uses. Additionally, competition for land will also affect food availability and prices, could lead to additional deforestation and thus provide additional threats to biodiversity. The intended CO<sub>2</sub> emission reduction by biofuels will often also be offset by the resulting land-use changes. The CO<sub>2</sub> mitigation potential of an increasing use of biofuels and all the unintended environmental consequences make their large-scale use controversial at least.

This paper will provide a timely review of the potential and consequences of biofuels. It will highlight some of the analytic flaws in scenarios that promote large scale use of biofuels. One of the main drawbacks of those studies is that crop production often is highly overestimated because local climate and soil conditions are not considered. Different life-cycle analysis, land-use modeling and scenario approaches will be presented and discussed. This review will provide insight in the factors that determine success or failure of biofuels. It concludes that biofuels under certain conditions can help in development, but that large-scale applications based on international CO<sub>2</sub> mitigation targets have too many negative social and environmental drawbacks.

**Keywords:** biofuels, climate change mitigation, land use, integrated assessment, scenarios

## **Lele Sharachchandra**

### **Markets or Governance? Contrasting Approaches to Biodiversity Conservation**

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Symposium S05, Biodiversity Change and Human Well-being

Societal approaches to biodiversity conservation have oscillated from one extreme of top-down exclusion and policing to another one based entirely on market-based thinking. These two extremes derive from a common understanding of the cause of biodiversity loss, viz., the non-congruence between local interests and global interests. But they prescribe different solutions based on different normative positions about other societal goals such as equity of outcomes and democracy of process, and different understandings of societal functioning and of biodiversity as a public good. While one clearly prioritizes the concerns of off-site stakeholders over those concerns of local communities, and shows little concern for equity or democracy, the other sidesteps these issues and focuses exclusively on efficiency, but thereby makes implicit assumptions about whose concerns will be valued. While one makes unrealistic assumptions about the power of the state to impose itself on local communities, the other makes equally unrealistic assumptions about the 'commodifiability' of biodiversity. The middle path of community based conservation suffers from lack of clarity on whether community involvement is normatively desired or instrumentally adopted. And this approach often assumes away the tension between local aspirations and conservationist goals. In this presentation, I shall draw upon a wide literature on conservation programmes in south Asia and elsewhere to analyse and compare the normative and analytical premises of different approaches to biodiversity conservation. Adopting more inclusive and socially sensitive approaches is essential for a more ethical conservation, but theoretical and practical considerations also indicate that putting in place hierarchical systems of democratic governance is a bigger challenge than designing or fine-tuning payment schemes.

**Keywords:** environmental governance, PES, property rights, public goods, normative framework

**Linder Hans Peter, Verboom George Anthony****The diversification of the Cape flora**

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Symposium S02, Evolution of biotic diversity in the Southern African winter-rainfall region

**Background**

The flora of the southern tip of Africa (the Cape flora) is remarkably species rich, with much of the richness being concentrated in just a few clades. The crown groups of several Cape clades date to the Oligocene, indicating a long history of in situ diversification. On the other hand, some clades have crown ages dating only to the Pliocene, indicating the recent and rapid diversification. The potential drivers of these radiations remain poorly understood, and some indications are contradictory. For example, while climatic stability may facilitate the persistence of diversity, climatic change might promote evolution of new diversity. Also, while environmental complexity may stimulate the evolution of novel forms, these might be susceptible to higher extinction rates owing to their local nature.

**Approaches**

We summarise existing information on diversification patterns in the Cape flora as a series of lineage through time (LTT) plots. In addition, for selected clades we explore the ecological correlates of diversification. We use field observations and geographical information systems (GIS) overlays to quantify the niches of the species and to relate changes in niche size to patterns of diversification, within a phylogenetic context.

**Results and Discussion**

Within the Fynbos element of the Cape flora, LTT plots show no evidence of distinct extinction or rapid radiation increase points during the Neogene. Recent radiations appear to be associated with more recent environments, such as those characterizing the Succulent Karoo, which became semi-arid only after the Pliocene, and the limestone flora, which was exposed only after the Miocene.

**Conclusion**

There is a relationship between diversification and environmental conditions, both in terms of the habitat diversity and long-term stability.

**Keywords:** Cape flora, Angiosperm, Diversification, palaeoclimate, radiation

**Lipper Leslie****Linking Payments for ecosystem services to sustainable land management in Africa**

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Symposium S14, Biodiversity and agricultural sustainability: from assessment to adaptive management

Modern agriculture has been very successful in providing the ecosystem services for which markets exist - crops, livestock, fish, fiber and wood. But producing these provisioning services has often come at a cost to the other regulating, supporting and cultural ecosystem services that are not directly covered by markets. The productive systems that lead to degradation of ecosystem services are often based on depletion of natural capital, hindering increases in productivity of the systems themselves and the improvement of rural livelihoods.

The adoption of sustainable land management (SLM) practices such as conservation agriculture, integrated nutrient and water management, agro-forestry, silvo-pastoralism and improved rangelands management, can enhance the production of ecosystem services (carbon sequestration, water quality and quantity, biodiversity preservation). In addition, these changes in agricultural technologies and practices can also lead to an improvement in the resilience, productivity and profitability of agricultural production systems. However, financial, institutional and technical barriers have prevented widespread adoption of these systems of production.

Payments for Ecosystem Services (PES) is an emerging policy tool with potential to bridge this gap by financing early SLM investment costs by capturing demand associated with SLM positive externalities, thereby lowering the cost barriers to SLM implementation. Farmers entering into agreements to adopt SLM practices may receive technical support and other incentives in addition to any gains in productivity associated with long-term adoption of such practices.

The presentation discusses how PES can contribute to better land management while improving the livelihoods of rural communities in Africa, and highlights the main constraints to be addressed in order to realize this potential.

**Keywords:** Ecosystem services, soil depletion, water pollution, sustainable agriculture, economic incentives

**Lonsdale Mark****Controlling invasive species through trade agreements: phytosanitary controls**

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Symposium S18, Globalization and Invasive Species: national responses, international options

The World Trade Organisation (WTO), and the various agreements that it administers, are critically important in considering how we can better manage invasives. The philosophical underpinnings of the various WTO agreements are rooted in jurisprudence, and seem to lead to an adversarial approach, with importers and exporters seeking to attack and defend each other's positions. However, the sheer numbers of species involved, the emergence of hitherto unknown harmful species, the inherently low predictability of the phenomenon, and the national inequalities of capacity to assess and manage risk, mean that it would be wiser for a collective good if we could shift the WTO's approach to manage biosecurity towards a model that is more adaptive, cooperative, precautionary, and allows new information to modify regulatory actions. The most relevant agreement for managing invasive alien species under the WTO is the Sanitary and Phytosanitary (SPS) agreement. The presentation explores measures that could help the international management of invasive alien species, including: Engender a culture of environmental awareness in the SPS committee and expand the membership of the committee to include biodiversity expertise; shift the approach under the SPS agreement from one of mechanistic, one-dimensional risk assessment to a precautionary approach that acknowledges uncertainty;

encourage the evolution of regulatory actions in response to new information;

build capacity for problem-centred information exchange and learning within the SPS system.

**Keywords:** Invasive species, trade, sanitary and phytosanitary measures, cooperation, risk assessment

**Luo Yiqi****Grassland biodiversity and ecosystem functions under climate change**

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Symposium S17, The role of forest biodiversity for ecosystem processes and services

Species composition in ecological communities reflects outcomes of interactions among organisms under a set of environmental conditions. Climate change alters essential environmental conditions and thus results in changes in species composition. The latter changes have long-term impacts on ecosystem functions. This presentation will examine impacts of experimental warming on compositions of plant and microbial species and their consequential influences on ecosystem processes in grasslands.

We have conducted a warming and clipping experiment in a North America tallgrass prairie. Infrared heaters have been used to elevate soil temperature by approximately 2°C continuously since November 1999. Clipping once a year was to mimic hay or biofuel feedstock harvest. Experimental warming increased C4 plant growth and decreased C3 plant growth. As a consequence, plant primary production, nitrogen use efficiency, and litter input to the soil all increased. Increased C4 litter production with low C:N slowed down decomposition and increased carbon accumulation in the litter layers. Decreased litter quality in response to warming resulted in a shift in the soil microbial community composition toward a fungi dominance and enhanced gene activation of nitrogen fixing microbes. Fungi dominance, in turn, could favor soil aggregation and carbon storage in ecosystems, thus reinforcing physical and biochemical protection of soil carbon storage. In addition, enhanced C4 plant dominance under climate warming resulted in increases in ecosystem rain use efficiency. Warming-stimulated root growth increased plant water uptake and the total amount of rainfall used by plants but with reduced water runoff. Thus, changes in species composition and community structure under climate warming have profound impacts on ecosystem production, carbon and nitrogen cycles, and water dynamics.

We will discuss our results under the context of other studies in different ecosystems.

**Keywords:** plant and microbial diversity, carbon cycles, nitrogen cycles, ecohydrology and water dynamics, climate warming

**Magallon Susana, Luna-vega Isolda****Phylogenetic composition of flowering plant diversity in the cloud forest of Mexico**

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Symposium S16, Evolution: the past, present and future of biodiversity

**Background and Goal**

Plant diversity is unequally distributed along geographical and ecological landscapes. Biodiversity hotspots have been recognized given

the number of endemic species they harbor, and the degree of threat to their existence. Members of the most ancient living lineages of flowering plants (angiosperms) inhabit humid, woody, mostly tropical habitats. The cloud forest of Mexico (CFM) houses extraordinary plant species diversity, including members of the earliest-diverging angiosperm lineages. Here, we use the CFM to investigate if tropical wet forest biomes contain a relatively higher proportion of early-diverging angiosperm lineages, and to seek an evolutionary explanation for the extraordinarily high diversity in the territory of Mexico, specifically in the Mesoamerican biodiversity hotspot.

### Methods

The significance of differences in the relative representation of orders, families and phylogenetic levels in the CFM with respect to the global flora were evaluated with G tests of goodness-of-fit. Overrepresented and underrepresented clades were identified through the net difference between the percentage represented by each in the CFM and in the world.

### Results and Discussion

Although a general congruence in the richest clades in the CFM and the global flora was found, the differences between their proportional global and local representations are significant. Overrepresented clades mostly belong to late-diverging phylogenetic levels, suggesting a slight predominance of late-diverging lineages in the CFM with respect to the global flora. Early diverging lineages are neither over- or underrepresented in the CFM.

### Conclusions

Early diverging angiosperm lineages show niche conservatism, and cloud forests provide habitats where they have persisted during their history. Angiosperm species richness in the CFM apparently results from a representation of ancient lineages in the face of accumulating diversity in late-diverging lineages.

**Keywords:** biodiversity, Mesoamerica, Neotropics, niche conservatism, phylogenetic level

## Maldonado Jorge, Moreno-sanchez Rocio

### **Does scarcity exacerbate the tragedy of the commons? Evidence from fishers' experimental responses**

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Symposium S10, Management tools for marine biodiversity

Common-pool resources as fisheries and other fauna and flora extracted resources, due to their nature of rivalry and non-exclusion, are exposed to over exploitation and risk of depletion. This phenomenon is known as the tragedy of the commons, and predicts that common-pool resources will be extracted up to the point in which benefits are exhausted, leading to excessive use. Economic Experimental Games (EEG) have challenged this theoretical prediction showing that individuals balance own and collective interests when making decisions on common-pool resource use, which deviate away from the predicted level of over exploitation (known as the suboptimal Nash equilibrium), moving towards the socially optimum level of extraction. However, few studies have analyzed whether these deviations from Nash equilibrium towards social optimum are affected as stock of resource changes. Performing EEG with real fishers we tested the hypothesis that behavior of participants –measured as relative deviations from Nash equilibrium- differs under a situation of abundance versus a situation of scarcity. The design of our EEG is based on a profit maximization model that incorporates inter temporal effects of aggregated extraction. Our findings show that in a situation of scarcity players over extract the resource making decisions above the Nash equilibrium, obtaining less profit, mining the others-regarding interest, and exacerbating the tragedy of the commons. This result challenges previous general findings from the EEG literature. When individuals face abundance of the resource, however, they deviate downward from the individualistic and myopic behavior prediction. This phenomenon of private inefficient over exploitation is corrected when management strategies are introduced in the game, which underlines the importance of institutional arrangements in CPR management. These results contribute to understand implications of biodiversity use and conservation in developing countries.

**Keywords:** Experimental economics, fisheries management, protected areas, common pool resources, marine biodiversity

## Manning Peter

### **Disentangling direct and compositional effects of climate change on ecosystem functioning**

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Symposium S17, The role of forest biodiversity for ecosystem processes and services

Global environmental change alters ecosystem function directly, by altering physicochemical properties and the physiology of organisms, and indirectly, by changing species composition and community structure. Historically, ecological research has tended to focus on the

mechanisms underlying one or the other of these changes, or has studied both processes simultaneously in phenomenological experiments. In consequence, the relative importance of the mechanisms underlying ecosystem responses to environmental change is rarely known and the functional consequences of compositional change in the context of altered abiotic conditions are poorly understood. Here I review the insights gained by recent studies in which the relative importance of direct and compositional effects have been estimated and discuss experimental methods which decouple these effects. I argue that ecologists must consider both direct and compositional effects before understanding how ecosystem functioning responds to global change. In doing so we must deal with compositional change as both a response and an effect variable and assess the importance of compositional changes, such as biodiversity loss, alongside other changes that influence functioning. We must also investigate the interaction between direct and composition effects and perform studies that determine the compositional resolution required to make informative predictions of future ecosystem functions and the services these confer.

**Keywords:** response and effects groups, composition, functional traits, biogeochemistry, precipitation

**Martens Koen**, Balian Estelle, Lévêque Christian, Segers Hendrik

**Taxonomy integrated with data analysis: FADA, the Freshwater Animal Diversity Assessment**

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Symposium S22, Biodiversity Science loosely joined: global approaches to taxonomy and biodiversity research supporting science and policy

The collective efforts of taxonomy provide the key to effective analyses of biodiversity patterns at the taxic level. An example of successful initiative in this is FADA, the Freshwater Animal Diversity Assessment. The project compiles overviews of genus- and species-level diversities of animals in the continental, aquatic ecosystems of the world. In a collective effort, 163 experts present the diversity and endemism of different animal taxa, ranging from microscopic worms to mammals, at global and regional scales in 59 papers (Balian et al., 2008) and databases (<http://FADA.biodiversity.be>). More than 120,000 species of freshwater animals have thus far been retained, 60% of which are insects. About 18,000 non-marine aquatic vertebrates (70% fish) and ca 13,000 species of crustaceans have also been identified. Whereas the available data on vertebrates and some emblematic invertebrate groups (e.g., Odonata) allow for a credible and detailed assessment, data are deficient for many other groups. These relate to knowledge gaps, both in geographical coverage and/or in taxonomy. Flagship groups are fairly well know around the globe, but potentially speciose keystone groups remain ill know, mainly in the southern Hemisphere. Such gaps may be addressed, either by liberating data from inaccessible repositories, or by fostering concerted taxonomic research within selected target regions and groups.

In a second step, compilation of environmental information will enable cross-linking and analysis of different data sets. Only in this way will it be possible to analyse information on freshwater biodiversity for sustainable management and conservation of the world's freshwater resources. This is relevant as freshwater at present comprises 0.01% of the world's total water supply yet only 0.8% of the earth's surface. Nevertheless, it holds 6-8 % of all described species and no less than 40% of all known fish species, a situation which we refer to as the 'paradox of freshwater'.

**Keywords:** taxonomy, databases, FADA, global, freshwater

**Martinet Vincent**

**Ecosystem-based fishery management and stochastic viability assessment**

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Symposium S10, Management tools for marine biodiversity

Managing natural resources in a sustainable way is a hard task, due to uncertainties, intertemporal issues, and conflicting objectives (ecological, social, and economical). In particular, sustainable management of fisheries must not only account for the preservation of the exploited resources and economic profitability, but also for environmental and ecosystem issues. In such a framework, assessing fisheries management rules is a difficult multicriteria dynamic decision problem.

We propose a stochastic viability approach to address such problems. This approach aims at identifying management rules such that a set of objectives is achieved with maximal probability over the planning horizon. We consider a dynamic ecological-economic model with uncertainties to represent the fishery. The sustainability of this system is described by a set of constraints, defined in practice by indicators together with thresholds. The results provided by this approach are twofold.

First, under appropriate mathematical properties on the dynamics and constraints (having economic and biological content), we characterize an optimal management rule, which maximizes the viability probability for the fishery. This rule is interpreted from a precautionary perspective.

Second, our framework makes it possible to assess the sustainability of given management practices and compare them in terms of their

ability to achieve conflicting objectives in the medium-long run. The connection is made between this approach and the so called Management Strategy Evaluation for fisheries.

We illustrate the general approach with numerical results in two application cases: the management of the Bay of Biscay Nephrops-Hakes mixed fishery, whose sustainability is jeopardized by bycatch, and the viability of the Chilean Jack-Mackrel Fishery, which faces El Niño cycles and environmental uncertainty.

**Keywords:** fisheries, ecological-economics, sustainability, uncertainty, viability

### **Matthee Conrad, Du Toit Nina, Edwards Shelley, Makokha Jane, Swart Belinda, Willows-Munro Sandi** **Patterns of faunal evolution in the Cape and Namaqualand**

Stellenbosch University, Botany and Zoology, South Africa, cam@sun.ac.za

Symposium S02, Evolution of biotic diversity in the Southern African winter-rainfall region

#### **Background**

Mitochondrial DNA phylogeographic investigations into the vertebrate fauna that are distributed throughout of the winter-rainfall region of Southern Africa indicated complex phylogeographical patterns. It is possible that cyclic climatic shifts throughout the Pleistocene significantly changed the distribution of many species and this in turn has influenced the genetic connectivity among geographic areas. In addition, different taxa, distributed throughout the same region, may show differences in phylogeographic structures due to discrepancies in life-history traits.

#### **Materials and methods**

We use mtDNA sequence data from three lizard (Bradypodion, Agama, and Pedioplanis) and three mammal (Myosorex, Rhabdomys, Otomys) taxa to compare the fine scale genetic structure throughout the Cape and Namaqualand of Southern Africa.

#### **Results and discussion**

Mismatch distributions and Fu's FS test support recent range expansions in several taxa but also suggest a fair amount of variation in the date since coalescence. Phylogeographic analyses support a diversity of patterns across the Cape Floristic Region (CFR) and Namaqualand and there is broad congruence between habitat specificity and mobility, and the genetic structure obtained. There is strong genetic evidence from the lizard data sets indicating that current levels of gene flow are restricted between the western winter rainfall region and the less seasonal eastern CFR. The mammal data do not show a similar trend in this region and the data generated from both Rhabdomys and Otomys displayed phylogeographic discordance following an altitudinal gradient. Genetic breaks/contact zones in the mammals investigated by us are situated to the eastern side of the CFR, and this region broadly corresponds to the Albany thicket biome, a structurally complex and transitional environment. High genetic diversity of fauna in the fynbos may be correlated to the species rich flora in this region.

**Keywords:** mtDNA phylogeography, lizard, mammal, Cape Floristic Region, South Africa

### **McGeoch Melodie, Spear Dian**

#### **The CBD 2010 Biodiversity Target: the invasive alien species indicator and national responses**

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Symposium S18, Globalization and Invasive Species: national responses, international options

Invasive alien species (IAS) are a major threat to biodiversity and as a result trends in IAS was selected as one of 22 Headline Indicators to measure progress towards the Convention on Biological Diversity's (CBD) target of reducing the rate of loss of biodiversity by 2010. The CBD calls on Parties to prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats, or species (Article 8(h)). Goal 6 of the CBD framework is to control threats from invasive species, and one of the targets under this goal is management plans in place for major alien species that threaten ecosystems, habitats or species. An indicator for measuring management responses to the IAS problem would thus be the number of operational management plans per country. However, limited data are available. Few data are available for parameters such as the number of IAS listed in national legislation and controlled by chemical, mechanical or biological control. An alternative indication of management responses in the short-term is whether the control of IAS is incorporated in national legislation. Less than 40% of countries populated to date include the control of IAS in their legislation and most of this IAS legislation has been enacted since the initiation of the CBD. The relationship between IAS-relevant legislation and management response and efficacy is uncertain, but legislation is nonetheless an essential element of national responses to existing and potential invaders.

**Keywords:** invasive alien species, indicator, management responses, policy, Convention on Biological Diversity

**Metzger Jean Paul**, Rodrigues Ricardo Ribeiro, Joly Carlos Alfredo

**Parameters to establish priority areas for terrestrial biodiversity conservation and restoration**

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Symposium S13, Mining biodiversity databases: examples for mountain biota and conservation planning

The BIOTA/FAPESP ([www.biota.org.br](http://www.biota.org.br)) research program on biodiversity inventory and conservation in the state of São Paulo (Brazil) has provided in the last 10 years one of the biggest georeferenced databank in tropical region, with more than 200,000 species occurrences. Despite the huge number of information, this databank also suffers with some common limitations, particularly with geographical and taxonomical gaps, and unequal sampling effort. In order to provide the state of São Paulo with useful guidelines for conservation actions, we proposed a new methodological procedure which allows going beyond the databank limitations. Particularly, we used an original combination of landscape structural parameters (fragment size and proximity) with biological data to define priorities areas for reserve site selections, connectivity improvement actions (e.g., riparian restoration, small particular reserve network, matrix enhancements), and biological inventories. Conservation guidelines were defined for three spatial scales (natural fragments, 5th order watersheds, and large watersheds), considering the occurrence of 3,326 focal species (from a total of 10,491 species), and the fragment size and connectivity parameters. We observed that landscape structural parameters can be useful biodiversity surrogates and valuable tools to establish general guidelines for conservation planning, specially where broad-scale species inventories and biodiversity distribution patterns are still unavailable, which is the case for most tropical areas. Results from this project have been extensively used by environmental and agricultural sectors of the São Paulo state government to provide a more solid database and conservation policy.

**Keywords:** Biodiversity, conservation, landscape structure, biodiversity surrogates, focal species

**Midgley Guy**

**No more business as usual for conservation under climate change – the need to consider biodiversity as a security issue**

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Symposium S01, Climate change and biodiversity: Adaptive management in the face of uncertainty

We suggest a definition of biodiversity security which is prompted by the necessity to balance the consideration of ecosystems with food, climate and energy security, as defined by the objective of Article 2 (the Objective) of the United Nations Framework Convention on Climate Change (UNFCCC). We demonstrate a direct dependence between a key requirement of Article 2 "[to] allow ecosystems to adapt naturally [to anthropogenic climate change]" and biodiversity, because it is the variation of genetic material imbued in biodiversity that provides the raw material necessary for "natural adaptation". This direct link, and the previously unrecognized implication in Article 2 of the UNFCCC that biodiversity lies at its heart, could help to justify a step increase in investment in ensuring biodiversity security, especially for the benefit of securing ecosystem services for human well-being. This might happen partly through a radical reassessment of conservation strategies to improve their pre-emption of climate change impacts, and by harnessing emerging signs of natural adaptation by wild species to ongoing climate change.

**Keywords:** Climate change, energy security, adaptation, UNFCCC, ecosystem services

**Moreno-sanchez Rocio**, Maldonado Jorge

**Can co-management improve governance of a common-pool resource? Lessons from a framed field experiment in a marine protected area in the Colombian Caribbean**

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Symposium S08, Spatial marine management and new approaches to marine ecology: A way out of the black box?

Coral reefs in the tropics constitute relevant ecosystems as they host high biological diversity. However, coral reefs are threatened due to human interventions which range from local extractive and non-extractive activities, such as fishing and tourism, to globally spread activities such as those causing climate change. Aware of the importance of coral reefs for the provision of ecosystem services, governments around the world have engaged in protecting them by creating marine protected areas. Despite conservation efforts, complexities associated to both management of common-pool resources and dependence of local communities on resource extraction –as their main income generation source–, reduce governance and do not allow environmental authorities to reach conservation goals. Using economic experimental games with local fishermen communities we tested different management conservation strategies in a marine protected area in the Colombian Caribbean: cooperation (internal communication), external regulation and co-management. Under co-management strategy, we explored complementarities between cooperation and external non-coercive authority intervention. Results confirm the effectiveness of communication and, to some extent, external regulation. However, co-management treatment exhibits –no matter where communities are located within the park– the best results in terms of sustainable use of the resource. Participants incorporated dynamic implications

in their decisions when information asymmetries were overcome through internal communication and external guidance. These results highlight the importance of resource management designs that recognize communities as key actors in decision-making processes for the sustainable use and conservation of biodiversity in protected areas.

**Keywords:** Common-pool resources, governance of protected areas, experimental economic games, fisheries, Latin America

## **Murdiyarso Daniel**

### **Deforestation, biofuels and biodiversity in SE Asia - the oil palm dilemma**

Center for International Forestry Research, Indonesia

Symposium S06, Biofuels and Biodiversity

Tropical deforestation is an important and growing source of CO<sub>2</sub>, as it has contributed 20 percent of the total annual emissions of CO<sub>2</sub> or around 8 billion tons in the 1990s. Although Asia's annual deforestation rate decreases, the contribution of emissions from Southeast Asia remains the highest across the tropics. Most of the deforestation is attributed to the development of oil palm plantations in Malaysia and Indonesia. The extent of oil palm plantations in these countries is almost equal and totaling almost 7 million ha.

More than 80 percent (26 million tons) of the world's palm oil is produced in Indonesia and Malaysia. The commodity is not only to supply international markets but also to meet the increasing domestic demands for biofuels. Malaysia is forging ahead with the domestic introduction of a blended palm oil fuel made up of 5 percent refined palm oil and 95 percent diesel. Since May 2006, diesel within Indonesia can contain up to 10 percent of biogenous fuel. In Malaysia palm oil production is to be increased from 11.8 to 18.8 Mt by 2020, which would extend the managed plantation from currently 3.5 million hectares to 5.1 million ha. Indonesia is catching up by developing another 3 million ha of new plantations.

The impressive expansions of oil palm plantations in Southeast Asia during the last decade have occurred at the expense of tropical forests. The environmental consequence of such scale of tropical forest conversion is under public scrutiny, especially when it is related to climate change and biodiversity issues. The plantations were found to support species-poor communities containing few forest species. Only pteridophytes were found to be higher in plantations. Trees, lianas, epiphytic orchids, and indigenous palms were wholly absent from oil

**Keywords:** tropical deforestation, oil palm expansion, species richness, conservation, public policy

## **Nyffeler Reto, Egli Urs, Edwards Erika J., Cornelia Klak**

### **Diversification of succulent plants in the winter-rainfall region of Southern Africa**

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Symposium S02, Evolution of biotic diversity in the Southern African winter-rainfall region

#### **Background**

The succulent life form has evolved independently numerous times resulting in an estimated 12'500 succulent species belonging to 80 families of flowering plants. The winter-rainfall region of southern Africa is particularly diverse in succulents, with about 1450 species in 23 different families. Most of this diversity is restricted to the Succulent Karoo region, where succulents constitute some 20 percent of the total flora. Dwarf and essentially stemless leaf succulents comprise about 65 percent, followed by shrubby leaf succulents, small stem succulents with seasonal photosynthetic leaves, and stem succulents of the cactus growth-form. In contrast, pachycaul and caudiciform succulents are underrepresented in comparison to other semiarid areas.

#### **Analyses**

We explore on the basis of divergence time estimates the ages of different clades of succulents and evaluate a correlation with the increased aridification in the recent geological past. Furthermore, we investigate whether the evolution of succulence overall led to an increase in species richness, and which factors or characteristics might have been influential for those groups occurring in the Succulent Karoo region. We focus on the succulent-rich order Caryophyllales, which is represented in the study area with succulents of the families Aizoaceae, Anacampserotaceae, Didiereaceae, Portulacaceae, as well as Talinaceae.

#### **Results**

In Caryophyllales, recent radiations in the winter-rainfall region of southern Africa are restricted to lineages that consist of small leaf succulents. Other succulent groups of this same order are only represented by few members with older divergence ages, possibly predating the onset of the aridification in late Miocene. These latter species-poor lineages rather seem to represent a relictual element in the succulent

flora. Rather mild arid conditions with a highly predictable rainfall regime seem to favour the diversification of leaf succulence over other growth-form types.

**Keywords:** succulence, growth-form type, radiation, relictual group, Caryophyllales

### **O'farrell Patrick, Anderson Philippa, Reyers Belinda, Le Maitre David**

#### **Tools for creating multifunctional landscapes**

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Symposium S04, Creating sustainable multifunctional landscapes: lessons from transdisciplinary programmes

Multifunctional landscapes are landscapes that harmonise human production and landscape use with ecosystem function, service flows and biodiversity retention. Historic land use patterns have tended to homogenise landscapes across all scales, restricting opportunities for both humans and wildlife alike. The emerging fields of ecosystem service research, conservation biology, and global change analysis have brought issues of species mobility, ecological connectivity, agricultural production shifts and human wellbeing into focus with regards to land use planning. The need for multifunctional landscapes is now being recognised from both socioeconomic and biological perspectives. However developing, creating and maintaining these landscapes is not clearly understood. We present initial findings from transdisciplinary collaborations within agricultural areas of South Africa. Investigating ecosystem services has enabled us to understand the impacts of system drivers on agricultural activities, service demand and supply, and biodiversity. Landscapes are being looked to for the provision of food security, livelihood opportunities, maintenance of species and ecological functions, provision of cultural, aesthetic and recreational needs, and for redressing past social and economic imbalances. Our analysis indicates that there are a number of preconditions necessary for the success of initiatives aimed at creating multifunctional landscapes, including cooperation between sectors, a critical level of support, community participation and the emergence of champions. Tools and enabling mechanisms that facilitate changes in land use include economic and fiscal incentives, research and information, legislation and policy, marketing, certification schemes, spatial planning, management guidelines, and restoration initiatives. Our findings are discussed in light of an emergent framework for understanding and creating multifunctional landscapes.

**Keywords:** sustainability, ecosystem services, livelihood strategies, connectivity, biodiversity

### **Olsson Per, Rosen Franciska**

#### **Navigating the transition to ecosystem-based management of the Great Barrier Reef, Australia**

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Symposium S10, Management tools for marine biodiversity

#### **Background and Goal**

We analyze the strategies and actions that enable transitions toward ecosystem-based management using the recent governance changes of the Great Barrier Reef Marine Park as a case study. We hypothesize that achieving such a shift is more complex than simply changing legislation, providing economic instruments, or introducing new restrictions on resource use.

#### **Methods**

We used qualitative methods and analysis to collect and analyze data.

#### **Results and Discussion**

A flexible organization, the Great Barrier Reef Marine Park Authority, was crucial in initiating the transition to ecosystem-based management. This agency was also instrumental in the subsequent transformation of the governance regime and provided leadership throughout the process. Strategies involved internal reorganization and management innovation, leading to an ability to coordinate the scientific community, to increase public awareness of environmental issues and problems, to involve a broader set of stakeholders, and to maneuver the political system for support at critical times. The transformation process was induced by increased pressure on the Great Barrier Reef (from terrestrial runoff, over-harvesting, and climatic change) that triggered a new sense of urgency to address these challenges. The aim was to strengthen ecosystems' resilience in the face of change, i.e., their ability to cope with disturbances and continue to generate essential ecosystem services. The focus of governance shifted from protection of selected individual reefs to stewardship of the larger-scale seascape.

#### **Conclusion**

The study emphasizes the significance of stewardship that can change patterns of interactions among key actors and allow for new forms

of management and governance to emerge in response to environmental change. It illustrates that enabling legislations or other social bounds are essential, but not sufficient for shifting governance toward adaptive co-management of complex marine ecosystems.

**Keywords:** adaptive governance, ecosystem-based management, transformation, resilience, stewardship

## **Palkovacs Eric**

### **Evolutionary influences on ecological processes**

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Symposium S16, Evolution: the past, present and future of biodiversity

Humans have become the most potent evolutionary force on earth, driving rates of phenotypic change in wild populations that now far outpace background rates of microevolution. These evolutionary changes have recently been shown to have important ecological consequences spanning multiple levels of organization (populations, communities, and ecosystems), system types (aquatic and terrestrial), and taxonomic groups (plants, vertebrates, and invertebrates). At the population level, genetic factors have been shown to influence population dynamics in wild sheep and butterflies. At the community level, differences among plant genotypes drive differences in arthropod communities, and recent phenotypic divergence among fish populations shapes zooplankton prey communities. At the ecosystem level, genetic variation in plants and fish influence rates of nutrient cycling, primary production, and decomposition. Moreover, these ecological changes brought on by contemporary evolution may feedback to further alter evolutionary trajectories. Evidence for these types of eco-evolutionary feedbacks has been found for predator-prey systems (rotifer-algae, fish-zooplankton) and for interactions between plant leaf chemistry and soil processes. Developing an integrated framework for addressing the effects of human activity on biodiversity must therefore include an appreciation for contemporary evolution and its ecological consequences.

**Keywords:** eco-evolutionary dynamics, contemporary evolution, populations, communities, ecosystems

## **Palmer Margaret**

### **River Futures: Can we recover lost biodiversity and ecosystem function?**

University of Maryland, Chesapeake Biological Laboratory, USA, mpalmer@umd.edu

Symposium S03, The Freshwater Biodiversity Crisis: a global threat to ecosystems and people

#### **Background and Goals:**

The rate of biodiversity loss in freshwater ecosystems is higher than losses in any other type of ecosystem. Over 30% of all freshwater fish are extinct or endangered and in the valley of Mexico alone all native freshwater fish are extinct. Losses of other freshwater groups are also significant, particularly mussels and crayfish. With approaching climate change, losses may even accelerate. This is of great concern because biodiversity loss is often associated with a decline of one or more ecosystem functions and since different species contribute differentially to different functions, the maintenance of multi-functional ecosystems requires maintenance of high species diversity. I provide an analysis of options for recovering biodiversity and ecosystem functions with a particular focus on inland running-waters.

#### **Materials and Methods:**

A review of the ecosystem goods and services that river and stream ecosystems provide was completed along with an analysis of current restoration approaches. A subset of riverine restoration projects was evaluated to determine how effective they were in restoring native biodiversity. Then recommendations were developed on how to improve restoration to recover lost services and species.

#### **Results and Discussion:**

Riverine ecosystems provide many goods and services; however, restoration efforts have largely focused on reconfiguring structural properties of rivers and streams assuming that this will result in recovery of biodiversity and functions. To date, this result has not been found. Instead, efforts need to focus directly on restoring the hydrogeomorphic and ecological processes that support ecosystem services (e.g., groundwater-surface water exchange, removal of excessive levels of nutrients and sediments, processing of organic material, primary productivity). Designing projects to accomplish process-based restoration requires a major paradigm shift among managers.

**Keywords:** freshwater, rivers, restoration, biodiversity, ecosystem

**Parr Catherine**, Bond William, Gray Emma

**Biodiversity consequences of a savannah-thicket biome switch**

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Symposium S23, Understanding complexity in African savannahs: People, climate and biodiversity

**Background and goal of study**

Globally many grasslands and savannahs are experiencing a thickening of woody vegetation. Many drivers have been suggested including altered fire and grazing regimes, enhanced atmospheric CO<sub>2</sub>, and nitrogen deposition. In South Africa the invasion of grassy systems by closed woody formations appears to be widespread in the eastern part of the country, and is potentially a key conservation threat in the summer rainfall regions of South Africa. In addition to better understanding the drivers of such a potential biome switch from grassy ecosystems to thicket/scrub forest, it is also critical to understand what the consequences of this change are for biodiversity and ecosystem functioning.

**Materials and methods**

Working in Hluhluwe Game Reserve, South Africa, we investigated the biodiversity implications of increased woody cover in the form of thickets. Specifically we compared richness, abundance and composition of herbaceous and woody vegetation, vegetation structural complexity, ground-active invertebrates, and habitat use by large mammals in eight paired adjacent savannah and thicket patches.

**Results and discussion**

Although there were some shared species, overall the two habitat types differed significantly in composition. Importantly, thicket habitats did not simply contain a higher density of woody savannah species, but the composition of species shifted significantly between habitats. Older thicket patches were more distinct from savannah patches in composition than younger thicket patches; this was the case for vegetation and invertebrates.

**Conclusions**

Our findings have important implications for biodiversity conservation, and suggest that in order to conserve a full range of biota a range of habitat types is needed. The development of thicket habitats in savannah conservation areas may require decisions on whether management should actively maintain savannahs.

**Keywords:** woody thickening, climate change, savannah, thicket, biodiversity

**Pearson Richard**

**Uncertainty in projections of biodiversity change for the 21st century**

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Symposium S01, Climate Change and Biodiversity: Adaptive Management in the Face of Uncertainty

A variety of modeling methods have been applied to estimate future impacts of climate change on biodiversity. For instance, one common approach – ecological niche modeling – utilizes associations between environmental variables and known distributions of species to identify environmental conditions within which populations can be maintained. Projection of modeled niches under scenarios of climate change enables the future distribution of suitable environments to be predicted and estimates of extinction risk to be made. In this talk I will outline some of the principal uncertainties in predictions of future impacts, and I will describe efforts to reduce uncertainty and make more informative predictions. I will conclude with thoughts on how uncertainty can be communicated to policy-makers and the general public, and the challenge for scientists in retaining objectivity.

**Keywords:** climate change, extinction risk, ecological niche modeling, species distribution modeling, uncertainty

**Pennington Toby**, Linares Reynaldo, Oliveira Filho Ary, Rotella Jay, Lavin Matt

**Evolution of dry forest in South America**

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Symposium S16, Evolution: the past, present and future of biodiversity

**Background and Goal of Study**

We aim to demonstrate that the ecology and patchy distribution of seasonally dry tropical forest (SDTF) in the Neotropics has distinctively structured the phylogeny and biogeography of woody plant groups that are confined to it.

### Materials and Methods

We use a database of almost 4000 woody species from 806 floristic inventories to investigate beta-diversity and endemism in SDTF. We examine the age and geographic structure of SDTF lineages using dated molecular phylogenies. We suggest a method based upon the isolation by distance model of population genetics that uses phylogenetic community distances to model phylogenetic niche conservatism.

### Results and Discussion

SDTF woody plant communities show high beta diversity, caused by few species being widespread between disjunct areas of this vegetation, and with many of these areas having high endemism. Isolated fragments of SDTF contain geologically old monophyletic radiations of endemic plant species, and intraspecific genetic variation is highly geographically structured. These patterns indicate a stable, dispersal limited SDTF system. SDTF species tend to belong to larger clades confined to this vegetation, suggesting phylogenetic niche conservatism. Phylogenetic niche conservatism between SDTF and neighbouring vegetations such as woody savannahs and rain forests is confirmed by a phylogenetic community approach that considers the entire flora, and not just exemplar clades.

### Conclusions

SDTF is the most threatened tropical forest biome and improved understanding of its distinct, long evolutionary history should provide impetus for its conservation. SDTF represents a distinctive theatre of evolution (metacommunity or biome) for woody plants. Phylogenetic, population genetic, biogeographic, and community ecological patterns differ in woody plants from tropical rain forests and savannahs suggesting an hypothesis that broad ecological settings strongly influence plant diversification in the SDTF.

**Keywords:** Metacommunity, dispersal limitation, phylogenetic niche conservatism, phylogenetic geographic structure, phylogenetic community structure

## Perrings Charles

### Globalization and the dispersion of species: The economic problem

ASU, School of Life Sciences, USA, Charles.Perrings@asu.edu

Symposium S18, Globalization and Invasive Species: national responses, international options

The widening and deepening of international trade has had a number of environmental consequences of which the most significant may well be the redistribution of species. There are two critical aspects to the problem. The opening of new markets or trade routes has resulted in the introduction of new species either as the object of trade or as the unintended consequence of trade, while growth in the volume of trade along existing routes has increased the frequency with which introductions are repeated.

To solve the economic problem posed by invasive species requires measures to 'internalize' the external costs of trade – to confront exporters and importers with the true cost of their actions. But it also requires defensive measures to mitigate import risks, to control established invasive species, and to coordinate international action to regulate pathways (trade routes). The problem is particularly hard to deal with in low income countries. Although such countries may be vulnerable to the effects of invasive species, they also have fewer resources to adopt effective sanitary and phytosanitary measures. This is especially clear in the case of infectious animal diseases – which not only reduce the value of output in agriculture in poor countries, but also prevent them from being able to access international markets for animal products. The paper explores the options for dealing with an issue that currently attracts more expenditures than any other environmental problem. It focuses on both the options open to individual countries to contain the local cost of trade-related species dispersal, and on the scope for international cooperation to reduce the invasive species risks of trade – especially those stemming from poor country exports.

**Keywords:** invasive species, trade, poverty, mitigation, adaptation

## Perrings Charles

### The governance of international environmental public goods

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Symposium S11, Effective governance for ecosystem services: the challenge of matching temporal and spatial scales

Biodiversity conservation is an example of an environmental public good. The non-exclusive and non-rival properties of such environmental public goods are partly inherent and partly socially constructed. For instance, exclusion is frequently a function of property rights and access rules, and this is particularly true at the international level where the decision-makers' remit (constituency, area of responsibility, legal authority etc.) may not map well to the physical systems affected by their decisions. The mismatch in the scale (both time and space) at which problems occur and are addressed creates a particular problem for governance. Kaul and Mendoza (2003) argue that the analogue to the fiscal equivalence principle in the provision of national public goods is 'the equivalence of publicness': that the set of stakeholders

in a transboundary environmental public good should be matched with the set of participants involved in negotiation over its provision. I consider the implications of such principles for the design of governance mechanisms for transboundary environmental public goods, and in particular for the design of Multilateral Environmental Agreements (MEAs) that govern many transboundary ecosystem services.

Keywords: environmental public goods, transboundary, exclusion, governance, multilateral environmental agreement

### **Pinto Ricardo L., Martens Koen, Schön Isa**

Genetic diversity in ancient asexual ostracods

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Symposium S12, Genetic drivers of freshwater biodiversity

#### **Background and goal of study**

Ostracods are small bivalve crustaceans found in almost every aquatic habitat. The ostracod family Darwinulidae is believed to be one of the few groups of animals that have survived for millions of years reproducing exclusively through parthenogenesis.

In order to understand the evolutionary implications of sexual versus asexual reproduction, we investigated the genetic variability of 5 species of Darwinulidae at three main levels: 1) between alleles (intra-individual); 2) between individuals (intra-specific); and 3) between species.

Finally, we looked for evidence of recombination and gene conversion in order to understand the evolutionary driving forces that may have shaped the genetic pattern of diversity in these asexual organisms.

#### **Materials and Methods**

Fragments of two nuclear markers were amplified (ITS1 and hsp82) from isolated individuals and then cloned into bacteria to allow the separation of individual alleles. Five species were investigated. Tests for recombination and gene conversion were performed with the software LDhat.

#### **Results and discussion**

All investigated species showed low genetic variability both within and between individuals, sometimes even for populations geographically far apart from each other.

Only very weak evidence for recombination was obtained with the tests, whereas there is strong evidence for gene conversion in several of the investigated species and in both nuclear markers.

These results could indicate that homogenizing genetic mechanisms are present in these lineages, possibly acting as an important process of molecular evolution to counter the disadvantages of the absence of sex.

#### **Conclusion**

Asexual lineages are in many aspects different from the sexually reproducing species and, for that reason, may deserve specific attention regarding their conservation. Besides, they can be used as evolutionary models to understand patterns and processes generating genetic biodiversity.

**Keywords:** genetic, diversity, asexual, fresh water, Ostracoda

### **Polasky Stephen**

#### **Effective governance for 'mainstreaming' ecosystem services**

University of Minnesota, Applied Economics; Ecology, USA, polasky@umn.edu

Symposium S11, Effective governance for ecosystem services: the challenge of matching temporal and spatial scales

Human society depends on vital goods and services provided by ecosystems. Economic systems, however, typically do not incorporate the full impact of production or consumption decisions on ecosystems or services. Unless we fix these systems to begin to properly account for the value of nature, 'mainstream' ecosystem services in decision-making, we are unlikely to see the types of fundamental changes necessary to sustain ecosystem services or conserve biodiversity. Mainstreaming ecosystem services requires: a) understanding the impacts of decisions on ecosystem change on ecosystem services and biodiversity, and b) tying the impacts to incentives, either by adjusting market prices, social norms, or government regulations. How well alternative methods of providing incentives will work to mainstream ecosystem services depends on the capacity of various formal and informal institutions. In situations with weak existing institutions some otherwise promising methods of providing incentives may not function well. We investigate ways to work around weak existing institutions and still provide incentives for ecosystem services provision as well as suggestions for key interventions in reform that would increase the effectiveness of incentives for ecosystem services.

**Keywords:** ecosystem services, governance, incentives, institutions, payments for ecosystem services

**Polasky Stephen****A landscape level analysis of trade-offs and synergies on carbon sequestration and biodiversity conservation**

University of Minnesota, Applied Economics; Ecology, USA, polasky@umn.edu

Symposium S09, Economic instruments for biodiversity conservation and ecosystem services

Nature provides a wide range of benefits to people. There is increasing consensus about the importance of incorporating “ecosystem services” into land and resource management decisions. There is also interest in knowing whether payments for ecosystem service will also promote biodiversity conservation. Using a set of integrated biophysical and economic models, we predict changes in ecosystem services, biodiversity conservation, and commodity production levels under different land use scenarios. Using data from the Willamette Basin, Oregon, USA, we compare the provision of carbon sequestration and species conservation under five simple policies that offer payments for services or species conservation. We evaluate policy performance compared to the maximum feasible combinations of carbon sequestration and species conservation on the landscape for various conservation budgets. None of the conservation payment policies produce increases in carbon sequestration and species conservation that approach the maximum potential gains on the landscape. Our results show that policies aimed at increasing the provision of carbon sequestration do not necessarily increase species conservation and that highly targeted policies do not necessarily do as well as more general policies.

**Keywords:** biodiversity, conservation, carbon sequestration, tradeoffs, payments for ecosystem services

**Quétier Fabien, Díaz Sandra, Lavorel Sandra, De Bello Francesco, Grigulis Karl,**

Robson T. Matthew

**Incorporating functional diversity into ecosystem service assessments: six steps and many questions**

IMBIV-CONICET, Argentina, polasky@umn.edu

Symposium S21, Linking biodiversity with ecosystem service provision: the role of functional diversity and spatial scale

**Background and goal of study**

Global environmental change affects the sustained provision of ecosystem services. Although the delivery of these services is strongly affected by abiotic drivers and direct land use effects, it is also modulated by the diversity of biological communities, and especially by the value, range, and relative abundance of functional traits in a given ecosystem: its functional biodiversity.

**Material and methods**

We present a semi-quantitative, six-step framework for integrating the different possible mechanisms by which functional diversity affects ecosystem properties that are directly relevant to ecosystem services. We propose a systematic way for progressing in understanding how land cover change affects these ecosystem properties through functional diversity modifications. Models on links between ecosystem properties and the local mean, range, and distribution of plant trait values are numerous, but they have been scattered in the literature, with varying degrees of empirical support and varying functional diversity components analyzed. Here we articulate these different components in a single conceptual and methodological framework that allows testing them in combination.

**Results and discussion**

We illustrate our approach with examples from the literature and apply the proposed framework to a grassland system in the central French Alps in which functional diversity, by responding to land use change, alters the provision of ecosystem services important to local stakeholders. We claim that our framework contributes to opening a new area of research at the interface of land change science and fundamental ecology.

**Keywords:** biodiversity, land change, mass ratio hypothesis, plant functional traits, subalpine grasslands

**Raffaelli David****Biodiversity and services: putting the system back in ecosystem**

University of York, Environment, UK, dr3@york.ac.uk

Symposium S21, Linking biodiversity with ecosystem service provision: the role of functional diversity and spatial scale

**Background and goal of study**

The relationships between biodiversity, ecosystem processes and the benefits enjoyed by society have been explored over the past 10 years using mainly reductionist experimental and modelling approaches to explore mechanisms and linkages. New approaches which recognise and acknowledge the increased spatial scale and complexities of real ecosystems are now needed.

Given that ecosystems are complex coupled networks of nodes, they represent the quintessential system the analysis of which is appropriately approached using a systems analysis framework. Interestingly, such approaches were advocated for coupled social-biophysical systems 40 years ago within the International Biological Programme, but this approach has remained at the edge of the very area it is best suited to tackle: the functioning of large scale ecological systems in the face of global change.

**Materials and Methods**

Network analysis is applied to two contrasting large scale systems: a Scottish catchment that has undergone extensive land-use and ecological change due to EU agriculture policy drivers, principally eutrophication; UK terrestrial ecosystems which are dominated by agriculture and forestry, but which have been challenged with policies to reduce or re-introduce large mammals (badger and beaver-wolf-lynx, respectively). Network metrics are derived which are appropriate for a range of ecosystem services.

**Results**

Analyses reveal large differences in underlying ecosystem processes, and hence the services they underpin, for different ecosystem states. Whilst some high-level metrics characteristically generated by network analysis are relatively easy to map onto services (e.g. primary production-related metrics and carbon sequestration), other services are more difficult to capture, specifically cultural services.

**Keywords:** systems-analysis, species-reintroductions, agriculture, metrics, large-scale

**Randin Christophe, Engler Robin, Vittoz Pascal, Guisan Antoine****Using georeferenced databases to assess the effect of climate change on alpine plant species and diversity**

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Symposium S13, Mining biodiversity databases: examples for mountain biota and conservation planning

**Background and Goal of the Study**

Past and current climate change has already induced drastic biological changes. We need projections of how future climate change will further impact biological systems. Modeling is one approach to forecast future ecological impacts, but requires data for model parameterization. As collecting new data is costly, an alternative is to use the increasingly available georeferenced species occurrence and natural history databases. Here, we illustrate the use of such databases to assess climate change impacts on mountain flora.

**Material and Methods**

We carried out projections of future distribution over the 21st century for 287 mountain plant species in the Western Swiss Alps. For each species, simulations were computed with a cellular automaton accounting for dispersal limitation and potential barriers in the landscape under four climate change scenarios. We then assessed the relationship between decrease in a species' distribution by 2100 and two biological traits: migration capacity and altitudinal distribution optimum.

**Results and Discussion**

Simulations yielded extinction rates between ~1% and 25%, and decreases in distribution for ~70% to 90% of the 287 species by the year 2100 across scenarios. Furthermore, high elevation and/or slow dispersing species are the most at risk in the face of climate change. Finally, we showed how georeferenced data of species occurrences, climatic and land cover spatial layers, species dispersal and species traits databases can be combined effectively to derive dynamic impact scenarios, suggesting upward migration of many species and possible regional disappearance when no suitable habitat is available at higher elevations.

**Conclusion**

Systematically georeferencing all existing natural history collections data in mountain regions could allow a larger assessment of climate change impact on mountain ecosystems in Europe and elsewhere.

**Keywords:** species distribution model, plant species, seed dispersal, Western Swiss Alps, climate change

**Remsen David****Creating a virtual library of biodiversity information: The GBIF Network**

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Symposium S22, Biodiversity Science loosely joined: global approaches to taxonomy and biodiversity research supporting science and policy

The Global Biodiversity Information Facility is an international organization established in 2001 with the mission to make the world's biodiversity information freely and universally available. This simple statement belies a much more complicated reality. To realize our vision to serve as a global, distributed, and virtual library of biodiversity information, we have had to overcome numerous challenges.

First, biodiversity information, as a concept, represents a vast array of information types, spanning the whole organizational range of biology, from molecular information to ecosystems data. Much of this information directly references taxa, primarily species. Information related to a species is tied to a scientific name, a name that may be neither stable nor unique. Effective access and delivery of this information requires accessing and integrating taxonomic expertise into the core information management framework of the system.

Next, there are issues of scale that effect not only integration but latency, sense of ownership to data publishers, evaluation of quality, and other critical aspects of use. The current network provides access to over 7,300 different datasets comprising over 170 million individual records that is expanding at the rate of 5%/month. This rate is accelerating as the scope of resources accessible through the network expands in response to user needs. The architectural components of the network must also evolve, moving from an initial, relatively centric topology, to a more distributed model, with a core central index and numerous, specialized data access nodes.

Lastly, we face the challenge of positioning the GBIF network among a larger ecosystem of initiatives, serving as one critical component within a virtual scientific process that collectively transforms data into knowledge.

**Keywords:** GBIF, species, primary, network, data

**Reyers Belinda, O' Farrell Patrick, Vlok Jan, Richard Cowling, Forsyth Greg, Schutte-Vlok Annelise****Building sustainable landscapes in a semi-arid biodiversity hotspot**

Council for Scientific and Industrial Research, Natural Resources and the Environment, South Africa, breyers@csir.co.za

Symposium S04, Creating sustainable multifunctional landscapes: lessons from transdisciplinary programmes

In many parts of the world, effective management of ecosystems is limited by the failure of existing knowledge to adequately support management decisions. This failure is linked to the challenges associated with fragmented, missing and dispersed data, as well as the obstacles which prevent the flow of information between scientist and manager. Our study aimed to improve management decisions in the Little Karoo of South Africa by attempting to address these two obstacles. This study, which involved scientists, managers and stakeholders, identified key knowledge gaps in decision making processes in the region. These included: the management of increased livestock numbers; concerns about flood damage; problems regarding water security and intentions to mine fossil water; and the increasing importance of tourism as an economic sector. The data needed were gathered from a wide range of sources including peer-reviewed literature, research and management databases, and expert consultation. The data were used to develop a range of products for use in decision making processes. The products demonstrated that current domestic and wildlife stocking rates are higher than recommended levels, that many wildlife species currently stocked are extralimital, and that previous decisions have left many ecosystems and their services in a vulnerable condition. They also directed attention towards new land use options e.g. restoration and job creation schemes, and more appropriate management interventions e.g. fire regimes and sustainable tourism. We found that the existence of a forum where scientists and stakeholders could interact was essential in bridging the gap between science and management. Furthermore, it was also useful in providing sources of new knowledge from land owners, managers and practitioners, which were a key component in developing these products.

**Keywords:** Ecosystem services, Tourism, Water, Carbon, Grazing

**Said Mohammed**, Norbert Henninger, Janet Nackoney, Paul Okwi, Godfrey Ndeng'e, Florence Landsberg, Patti Kristjanson, Robin Reid, Dan Tunstall, Greg Mock

**Using Geospatial Information to Connect Ecosystem Services and Human Well-Being in Kenya**

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Symposium S14, Biodiversity and agricultural sustainability: from assessment to adaptive management

**Background and Goal of Study**

Nature's Benefits in Kenya: An Atlas of Ecosystems and Human Well-Being integrates spatial data on poverty and the environment in Kenya, providing a new approach to examining the links between ecosystem services (the benefits derived from nature) and the poor. This publication focuses on the environmental resources most Kenyans rely on to earn their livelihoods, such as soil, water, forest, rangeland, livestock, and wildlife.

**Material and Methods**

The atlas overlays georeferenced statistical information on population and household expenditures with spatial data on ecosystems and their services (water availability, wood supply, wildlife populations, and the like) to yield a picture of how land, people, and prosperity are related in Kenya.

**Results and Discussion**

This information can be used in developing poverty reduction programs and in designing policies for water resources management, agriculture production, biodiversity preservation, and charcoal production, among others. The maps and analyses presented here will not provide easy answers to questions concerning the causes of poverty in Kenya and how ecosystems can best be managed to increase economic growth and improve livelihoods.

**Conclusions**

These are a first step toward stimulating more informed dialogue and provoking questions for which answers may be found. With up-to-date data and additional analyses, the implementation of Kenya's Economic Recovery Strategy (and its successor strategy) can be targeted to specific geographic areas of the country, focusing on the poor, and making better use of Kenya's natural resources.

Keywords: Ecosystem services, Poverty, Livelihood, Kenya, Spatial Analysis

**Santos Rui**, Ring Irene, Antunes Paula

**Fiscal transfers for biodiversity conservation: Experiences and prospects**

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Symposium S09, Economic instruments for biodiversity conservation and ecosystem services

Local actors, both public and private, often have to bear costs for the provision of public goods and services, like nature conservation, while benefits are captured beyond their boundaries, creating spillover benefits or positive spatial externalities. In these cases, there are no incentives for local actors to engage in conservation activities. In order to align the objectives of local public institutions and the private sector to achieve conservation goals, policies that stimulate such engagement are required.

Fiscal transfers help to match the allocation of financial resources with the assignment of public functions to be fulfilled by different public entities, and contribute to the internalisation of spatial externalities. They allow compensating for expenditure incurred by local governments in conservation policies and for opportunity costs resulting from land-use restrictions imposed by protected areas.

The objective of this contribution is to better understand the potential and constraints of fiscal transfers for biodiversity conservation, considering the ecological, economic and policy perspectives, and learning from two experiences. Both Brazil (Ecological ICMS) and, more recently, Portugal (Local Finances Law) have implemented ecological fiscal transfers to compensate municipalities for the costs imposed by protected areas. These two instruments are discussed and compared, with particular attention directed to the incentive effects, considering the relevant governance levels (from national/state to local and from local to land owners). The interplay with other instruments as, for example, the agri-environmental and conservation programmes that exist in Europe to compensate land users for environmental services is also discussed.

**Keywords:** Fiscal transfers, Biodiversity conservation, Local actors, Brazil, Portugal

**Scholes Robert****Toward a Global Biodiversity Observing System**

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Symposium S07, Analysis and forecasting of biodiversity and ecosystem processes: a contribution to GEO BON

The Group on Earth Observations Biodiversity Observation Network (GEO BON) is a new global partnership to help collect, manage, analyse and report data relating to the status of the world's biodiversity. GEO BON represents the Biodiversity Societal Benefit Area of GEOSS, the Global Earth Observation System of Systems. Its mandate is to provide, in an operational way, the observations needed to document changes in biodiversity, at the genetic, species and ecosystem levels, at global scale. It does so by helping to coordinate the activities of national and international bodies in this field, facilitating their collaboration and data-sharing, promoting links to users, and advocating actions to fill data gaps.

The talk will present the overall framework envisaged for GEO BON, and illustrate how GEO BON plans to identify priorities for data collection at the ecosystem, species and genetic level, in order to enable local relevance and global coverage, while remaining feasible and affordable. The talk will further illustrate how GEO BON will build upon existing monitoring programmes including those presented at this symposium, and will provide examples of its added value.

**Keywords:** RJ Scholes, CSIR, Natural Resources and Environment, S-Africa, GEO BON

Schon Isa, **Martens Koen**, Birky Jr Bill, Bode Saskia, Halse Stuart, Butlin Roger K,

**Cryptic species in non-marine ostracods**

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Symposium S12, Genetic drivers of freshwater biodiversity

**Background and goal of study**

Over the last years, genetic research using the mitochondrial COI gene has discovered countless cryptic species in various animal groups. These are morphologically similar but genetically different species. Here, we have studied cryptic species in non-marine ostracods. Ostracods are small bivalved crustaceans found in almost all aquatic habitats. Of the three major ostracod lineages, the Cypridoidea are by far the most speciose group, comprising c 1500 described species, about 3/4 of the total number of non-marine ostracods. They are either sexual or have mixed (sexual and asexual populations) reproduction or are completely asexual. The ancient asexual darwinulids are at present far less speciose with only about 35 living species in 5 genera.

**Material and methods**

We have obtained COI DNA sequences from four non-marine ostracod species: *Eucypris virens* (cyprid) from Europe and Northern Africa and the darwinulids *Darwinula stevensoni* from Europe and Africa, *Penthesilenula aotearoa* from Brazil and *P. brasiliensis* from Brazil, Europe and Australia.

**Results and discussion**

The morphospecies *E. virens* displays up to 35 cryptic species, which neither follow the reproductive mode nor show a clear geographic pattern. If other cyprid species have similar numbers of cryptic species, ostracods are much more diverse than previously assumed. No cryptic species were observed in *D. stevensoni* or in *P. aotearoa*. In *P. brasiliensis*, however, we find five cryptic species. One occurs in Europe, a second in Australia and the remaining three are found in Brazil from similar habitats and in close geographic proximity.

**Conclusions**

Models predicting the loss of freshwater fauna (e.g. Riccardi & Rasmussen 2001 for North America) are based on 'classic' species. If some of these also harbour cryptic species, the loss of biodiversity will be even more dramatic.

**Keywords:** Genetic, cryptic, species, Freshwater, Ostracoda

Schultz Lisen, Cecilia Lundholm

**Local stewards, learning and management of ecosystem services: examples from Biosphere Reserves**

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Symposium S04, Creating sustainable multifunctional landscapes: lessons from transdisciplinary programmes

**Background and Goal of Study**

Biosphere Reserves are areas designated by UNESCO to be 'sites of excellence' and 'living laboratories' for the integration of biodiversity conservation and sustainable development. Securing ecosystem services is a core mission of these sites. With a strong focus on monitoring, research and education, they should also serve as learning sites in this regard. The goal of this study is a) to investigate how Biosphere Reserves function as learning sites, and b) highlight some of the lessons learned in these sites, with a focus on the role of 'local stewards', i.e. local inhabitants involved with monitoring and on-site management of ecosystem services.

**Materials and Methods**

This study uses survey responses from 148 Biosphere Reserves in 55 countries, semi-structured interviews with key informants from ten of these reserves (selected as potential learning sites on the basis of their survey responses), and a case study of Kristianstads Vattenrike Biosphere Reserve in Sweden.

**Results, Discussion and Conclusions**

A subset (79) of the Biosphere Reserves serve as 'potential learning sites' and a) coordinate and support the generation of new social-ecological knowledge through research, monitoring and experimentation, b) provide platforms for mutual and collective learning through face-to-face interactions, and c) frame information and education to local stewards, resource-based industries, policy-makers, disadvantaged groups, students, and the public. The case study shows that local stewards are particularly important for management of ecosystem services. They can provide on-site ecosystem management, long-term and detailed monitoring of species and ecosystem dynamics, local ecological knowledge, they increase public support for ecosystem management and they are connected to specialized networks. Involving local stewards in multi-level, learning-oriented ecosystem management has the potential to enhance the generation of ecosystem services.

**Keywords:** learning, ecosystem services, ecosystem management, governance, resilience

Seehausen Ole

**Loss of diversity through the reversal of speciation**

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Symposium S16, Evolution: the past, present and future of biodiversity

**Background & Goal**

A considerable fraction of the world's biodiversity has evolved as a by-product of divergent selection between environments, and is maintained by divergent adaptation in heterogeneous environments. Many such species could exchange genes was it not that adaptation to different ecological niches typically restricts gene exchange between them. Conservation geneticists have paid attention to genetic homogenization caused by human-induced translocations (e.g. biological invasions). Conservation-minded ecologists have paid attention to the importance of environmental heterogeneity for the ecological coexistence of species. However, far less attention has been paid to the consequences of loss of ecological landscape heterogeneity for neutral and adaptive genetic differentiation of sympatric species.

**Methods**

I will introduce some theory on ecological causes and evolutionary consequences of interspecific hybridization. I will show that interspecific hybridization can facilitate an increase or a decrease of species diversity, or can be neutral, depending on the ecological landscape. Where populations experience a heterogeneous ecological landscape with multiple ecological opportunities, hybridization, through increasing genetic variation can facilitate diversification. On the other hand, where populations experience reduced landscape heterogeneity, hybridization, through causing the breakdown of divergent adaptation can facilitate loss of diversity, effectively reversing ecological speciation. I will then review empirical data that suggest that loss of ecological landscape heterogeneity drives the loss of genetic isolation-by-adaptation. Data on several different systems suggest that this is a major, but overlooked, cause of rapid loss of species diversity.

**Conclusions**

Because heterogeneity of natural environments is rapidly deteriorating in most biomes, I suggest that it is timely to fully integrate the evolutionary ecology of speciation reversal into applied conservation biology.

**Keywords:** speciation, hybridization, environmental heterogeneity, extinction, evolution

**Smith Katherine****Analyzing the wildlife trade as a risk for international disease spread**

Brown University, Ecology and Evolutionary Biology, USA, katherine\_smith@brown.edu

Symposium S20, Ecological and economic impacts of disease emergence through wildlife trade: consequences for biodiversity and public health policies

**Background and goal of study**

International trade in live animals has facilitated the introduction of species to new regions, where they compete with native species for resources, alter ecosystems, damage infrastructure, and destroy crops. It has also led to the introduction of pathogens that threaten public health, agricultural production, and biodiversity. We present the most thorough and up-to-date report on the scope and scale of live animal trade (by which we mean wildlife, not domesticated animals) by one of the world's primary wildlife importers, the United States.

**Materials and methods**

We obtained and analyzed all U.S. Fish and Wildlife Service records for live animal imports and exports declared for the period 2000–2006.

**Results and discussion**

Over half a million shipments containing >1.68 billion live animals have been traded by the U.S since 2000. Nearly 78% of shipments were imports, 92% of which were designated for commercial purposes (i.e. pet trade). Nearly 80% of imported shipments contained animals from wild populations, the majority of which are not tested for pathogens before or after shipment, nor held in quarantine after arrival to assess their health status. Annual shipments of live animals imported by the U.S. increased significantly from 2000 to 2006. Six countries supplied over 74% of live animals imported to the country, nearly all of which originated in Southeast Asia.

**Conclusions**

We discuss three avenues for reducing the risks associated with wildlife trade. Foremost, scientific risk analysis of imported taxa, at the level of genus or species, would provide a significant advance in assessing the magnitude of the threat that live animal importation poses. To reduce the risk of pathogen introduction via live animal import, measures could include third-party screening of animals in the country of origin for high-priority diseases prior to importation. Finally, public education campaigns can assist in raising awareness of the risks of contamination.

**Keywords:** wildlife, trade, emerging disease, zoonoses

**Smith Vincent S., Roberts David, Rycroft Simon D.****Small pieces loosely joined: towards a unified theory of biodiversity for the web**

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Symposium S22, Biodiversity Science loosely joined: global approaches to taxonomy and biodiversity research supporting science and policy

**Background**

Biodiversity science is characterised by a single immense goal (to document, describe and synthesise all facets pertaining to the diversity of life) that can only be addressed through a seemingly infinite series of smaller studies. The complexity of connecting these small studies with biodiversity science's goal has made it hard to apply their value to global scientific and policy-making agendas. Digital technologies provide the means to bridge this gap.

**Materials and methods**

In this presentation we describe the architecture and template design of "Scratchpads", a data-publishing framework for distributed groups of people to create their own social networks supporting biodiversity science. Scratchpads cater to the particular needs of individual research communities through a common database and system architecture. This is flexible and scalable enough to support multiple

networks, each with its own choice of features, visual design, and constituent data. Users can automatically supplement information they submit with data drawn from high quality web accessible databases (e.g. Genbank, GBIF, Biodiversity Heritage Library, flickr and Google Scholar), helping to unify distributed biodiversity resources. Our approach allows communities to bridge the social, technical and policy barriers that hinder biodiversity data integration and is illustrative of similarly niched activities contributing to global efforts in biodiversity science.

### Results and discussion

The Scratchpad framework (<http://scratchpads.eu/>) currently serves more than 1,000 registered users across 97 sites, spanning scientific, amateur and citizen science audiences in more than 30 countries. The template of our architecture serves as a model to illustrate how diverse and distributed data sources can be standardized and unified through a common platform serving biodiversity scientists.

**Keywords:** Biodiversity, Taxonomy, Web 2.0, Scholarly communication, Community

## Springborn Mike

### Closing the gap between risk estimation and decision-making: efficient management of trade-related invasive species risk

University of California Davis, Environmental Science & Policy, USA

Symposium S18, Globalization and Invasive Species: national responses, international options

We assess multiple alternatives for designing a screening system to make decisions to allow or exclude novel imported flora. The statistical decision problem is to use available information on previous imports to parameterize a predictive model of the key unknown--a proposal's latent status as damaging or benign. We develop the first side-by-side comparison of two classical approaches--maximum likelihood and Bayesian--against a third, recently developed "maximum utility" (MU) estimation methodology. We demonstrate the implications of the expected payoffs (benefits and potential damages) of a risky import for the risk estimation problem. While Bayesian methods for incorporating actual expected costs of error into statistical estimation are known, for the class of discrete action/outcome problems of interest here, where the probability of a future state is the focal unknown, Bayesian estimates are independent of payoffs and do not take advantage of the structure of the problem. In contrast, the MU approach uses the insight that a global fit of the model is less important than the localized problem of identifying the best switching point from one discrete decision to another, e.g. from rejection to acceptance of a proposed import. We develop an empirical application using Australian data based on the problem of choosing to reject or accept novel plant imports given that the primary unknown is whether or not the proposal will become invasive. For each methodology, we show how to account for a non-random, endogenously stratified sample, a problem commonly encountered with rare events data. We demonstrate when the MU method is likely to offer significant incremental gains relative to the alternatives and estimate this annual value to be \$32-\$66 million (AU\$). We find analytically that if additional resources are available to gather more complete information about a proposal, efforts should be biased towards proposals that are otherwise slated for acceptance.

**Keywords:** risk assessment, invasive species, maximum utility estimation, Bayesian decision theory, economics

## Sturmbauer Christian

### New insights on explosive speciation and adaptive radiation from East African cichlid fishes

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Symposium S12, Genetic drivers of freshwater biodiversity

### Background and goal of study

The species flocks of cichlid fishes in the three Great East African Lakes, Victoria, Malawi and Tanganyika, provide excellent model systems to study speciation and adaptive radiation. Due to their different age, species flocks evolved to different levels of eco-morphological and genetic divergence. While the connection of speciation and eco-morphological divergence is a central feature of the theory of adaptive radiation, evidence in nature is scarce. Our goal was to elucidate pathways, common patterns and differences in the three radiations, and the role of natural selection in driving the process.

### Materials and methods

We analyzed DNA sequences, AFLP and microsatellites of several lineages and studied populations by combining population genetics and comparative morphometrics.

### Results and Discussion

Phylogenetic analyses not only suggested similar patterns of diversification, they also linked the three radiations by placing the origin and spread of the haplochromine cichlids, the most species-rich group of cichlids, right within the primary radiation of Lake Tanganyika. Concerning pace and timing, radiations were most likely catalyzed by the interplay of geological and biological processes, indicating a truly “explosive” pace at the beginning, as evidenced by the tree shape of the molecular phylogenies of Lake Malawi Mbuna and the Tanganyikan tribe Tropheini. Concerning the connection of speciation and eco-morphological divergence, our experimental study of closely related allopatric populations and sympatric sister species of the genus *Tropheus* demonstrated small but clear differences in morphology among sym- and allopatric entities. Divergent selection on particular morphological characters is likely to act in sympatry, while allopatric populations seem to be under stabilizing selection. Patterns observed in populations of sympatric species pairs are consistent with character displacement driving morphological divergence.

**Keywords :** Molecular phylogenetics, population genetics, geometric morphometrics, natural selection, phylogeography

### Sullivan Caroline

#### Understanding the anthropocentric value of wetland functionality as a means of supporting habitat protection and freshwater biodiversity

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Symposium S03, The Freshwater Biodiversity Crisis: a global threat to ecosystems and people

Wetlands are highly valuable systems both ecologically, and from a human perspective. They form a key part of the hydrological cycle, but a serious degree of ignorance still exists about the biophysical processes that support them, and the values that they hold. While some wetland types are widely found and easily accessible, others are considered unique, being classified as having particular significance to society. Internationally, such wetlands are identified as Ramsar Sites, and protected by the implementation of appropriate legislation.

While the objective of such legislation is to protect the integrity of wetland systems, it is important to recognise that even within legislative constraints, such wetlands can generate a wide range of valuable economic benefits. In contrast to this, other wetlands may be seen as being so extensive that scarcity is not perceived, and thus values are not appreciated. In such cases, these wetlands are often drained and converted to other forms of land use, giving rise to a loss of important ecological capital. To prevent this, it is vital to ensure that those responsible for land management can understand the value of the ecosystem services that these wetlands may have.

In this paper, a selection of specific wetland sites in the upper Orange basin of Southern Africa are identified, and in each of these wetland types, a key function is selected. These diverse wetland functions have then been quantified from survey data collected at the sites (and from other relevant sources), and an economic valuation of these functions has been calculated, using a variety of approaches. By providing such a suite of functional values, it is hoped that this work can contribute to a better understanding of the anthropocentric importance of wetland systems, to support more effective legislation for the protection of the freshwater habitats they provide, and the biodiversity so critically dependent upon them.

**Keywords:** wetlands, valuation, biodiversity, conservation, ecosystem services

### Sunderland Terry, Pfund Jean-Laurent

#### Key information for landscape assessment, planning and monitoring

CIFOR, Livelihoods, Indonesia

Symposium S15, Research for adaptive management of biodiversity-rich tropical landscape mosaics

#### Background and goal

Integrated Conservation and Development Projects (ICDPs) have for decades focused on trying to balance conservation and development interests but have had mixed results. Many scientists and development specialists have tried to understand what the factors of success and failures of ICDPs have been. This has led to the development of a set of analysis criteria from which one can try to distinguish more or less important variables. Nowadays the conservation-development nexus is thus still being analyzed through different lenses and data sets especially through the landscape concept, which has become recognized as a help to combine ecosystem services, spatial patterns and livelihood or development concerns.

#### Methods

Based on several multisite datasets, multivariate analyses of sites and projects as well as information from our current field experiments, the paper discusses how to define, and what could be designated as, a critical set of information to assess, plan for action and then monitor conservation and development trends at the landscape scale.

**Results and conclusions**

The purpose of the paper is not to advocate a standard data set for landscape assessment but to improve our ability for defining participatory indicators of biodiversity conservation and livelihoods as well as for ensuring relevant longer term observations of landscape trajectories.

**Keywords:** Landscape assessment, Conservation, Landscape monitoring, ICDPs, Multivariate datasets

**Swartz Ernst**, Chakona Albert, Ramojane Mpho, Skelton Paul, Bloomer Paulette  
**Ecological differentiation affects population history of two South African redbin species (*Pseudobarbus*, *Cyprinidae*) from the Cape Floristic Region**

South African Institute for Aquatic Biodiversity, South Africa, e.swartz@saiab.ac.za

Symposium S02, Evolution of biotic diversity in the Southern African winter-rainfall region

**Background and goal of study**

A neglected aspect of fish phylogeography in the Cape Floristic Region has been the role that ecological differences between species play in allowing maintenance of gene flow between historically isolated river systems, whilst some species remained isolated. *Pseudobarbus asper* and *P. tenuis* show major differences in habitat preferences despite being sister species. We tested whether contrasting ecologies resulted in differential inter-drainage dispersal and differences in geographic genetic structuring. We also refer to other Cape species.

**Materials and methods**

We collected samples from 36 localities across the Gourits, Gamtoos, Keurbooms and Bitou River systems and assessed mitochondrial DNA control region sequence variation.

**Results and discussion**

Two lineages of *P. tenuis* exist, one occurring in the Gourits system often in sympatry with *P. asper*, and the other in the coastal Keurbooms and Bitou systems. *Pseudobarbus asper* showed negligent differentiation between the Gourits and Gamtoos systems. The river capture of south-eastern tributaries of the Gourits by the Keurbooms River may have resulted in unidirectional colonization of the latter by *P. tenuis*.

**Conclusions**

The reason for the absence of *P. asper* from the Keurbooms and Bitou systems, and of *P. tenuis* from the Gamtoos system, may be accounted for by their respective habitat preferences. The Bitou and the Keurbooms systems lack the "Karoo type" streams required by *P. asper*. Unlike *P. tenuis*, *P. asper* may have been missed in river capture events, since they do not occur in upper reaches of headwater streams where river capture is more likely to occur. If *P. asper* entered the Gamtoos via source wetlands in Karoo tributaries, then the absence of *P. tenuis* might be the consequence of its absence from these Karoo tributaries.

**Keywords:** Phylogeography, ecology, habitat preference, population history, *Pseudobarbus*

**Tockner Klement**, Sommerwerk Nike, Tonolla Diego, Freyhof Joerg, Venhor Markus, Hering Daniel  
**Setting priorities for conserving freshwater biodiversity at the catchments scale**

Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Germany

Symposium S03, The Freshwater Biodiversity Crisis: a global threat to ecosystems and people

There is consensus that the catchment is the key spatial unit to investigate and manage freshwater biodiversity. However, information is mostly available at the country level; data are unevenly distributed, and long-term data are very rare. The goals of this study are to identify priority areas for developing efficient proactive (i.e. conservation) and reactive (i.e. restoration) management strategies for freshwater biodiversity, and to determine the appropriate spatial scale for implementation.

The European Catchment Data Base, endorsed by the freshwaterBIODIVERSITY cross-cutting network, contains spatially-explicit information for 165 catchments on environmental trends (hydrology, water temperature, land use, water stress) and species diversity patterns (wetland birds, amphibians, fish, benthic invertebrates, and crayfish) across entire Europe. The data base has been implemented in Access and is linked with GIS-layers.

Catchments on the Iberian Peninsula, the southern Balkan and Anatolia contain the highest proportion of irreplaceable freshwater species. These particular regions are expected to face an even higher increase in environmental pressure in the near future. Along river corridors, vegetated islands as well as delta areas are identified as key nodes for biodiversity. Few relatively unmodified catchments are remaining in

Europe; hence there is an urgent need to establish a network of "reference" catchments. Further, we need to incorporate other ecosystem aspects such as the evolutionary potential of a system or its capacity to perform key ecological processes in future conservation and restoration planning.

In summary, we provide a comprehensive overview of the European freshwater biodiversity, its main stressors, and define clear criteria for setting priorities for their sustainable management.

**Keywords:** catchment, freshwater, restoration, conservation, stressors

## **Van Noordwijk Meine**

### **Climate Change, Agrobiodiversity and Sustainability in Agroforestry Systems**

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Symposium S14, Biodiversity and agricultural sustainability: from assessment to adaptive management

Climate change adds a trend to current climate variability, but it is the variability part that we can empirically study. Diversity provides livelihood buffer to the uncertain performance of components of farming systems. Sustainability focuses on the properties of the agroecosystem that allow farmers and other land uses to continuously change and adapt the way they manage their resources. Examples will be drawn largely from studies in Sumatra where 'rubber agroforests' have combined a few introduced tree species with the local tree flora for production systems aimed at high returns to labour at low investment of capital. Options to benefit from latex, fruit and timber yields have ups and downs along with global markets and national regulation, but have so far made the maintenance of diversity attractive. Years with long dry seasons, economic shocks that lead to a temporary urban-rural return migration and shifts in market prices all require flexibility in the land use system, that can be provided as long as there is elasticity in the output per unit labour input response curves. The regeneration of forest diversity in the rubber agroforestry gardens, however, may be at risk under current intensification. Market-based recognition of the co-benefits of higher terrestrial C stock and contributions to global biodiversity concerns is probably needed to keep the diversified systems competitive against the tree monocultures (oil palm and rubber) that are technically and economically feasible in the lowland humid tropics.

**Keywords:** Agroforest, livelihoods, Rubber, Sustainability, Sumatra

## **Venter Oscar, Wilson Kerrie, Iwamura Takuya, Fuller Richard, Possingham Hugh**

### **Conserving forest biodiversity through global efforts to reduce carbon emissions from deforestation**

The University of Queensland, School of Biological Sciences, Australia, oventer@uq.edu.au

Symposium S09, Economic instruments for biodiversity conservation and ecosystem services

#### **Background and goal**

Thirteen million hectares of tropical forests are cleared each year, releasing huge amounts of stored carbon into the atmosphere and condemning many species to endangerment or extinction. Initiatives to reduce emissions from deforestation in developing countries (REDD) seem poised to protect these threatened forests. The goal of these payments will be to protect stored forest carbon, yet it is widely hoped that this will also contribute to the conservation of forest biodiversity. In this study we determine the extent to which this is true and explore the trade-offs between carbon and biodiversity outcomes at the global scale.

#### **Methods**

We use a dynamic decision-theory framework that integrates information on carbon storage, baseline deforestation rates and the opportunity costs of conservation to develop a schedule for REDD intervention. We determine the biodiversity co-benefits using data on the number of endemic forest using amphibians, birds and mammals in each country and the species-area relationship.

#### **Results and discussion**

We discover that allocating REDD funds globally to protect forest carbon yields greater protection for endemic forest vertebrates than randomly protecting forest, but not nearly so much as spending explicitly to maximize biodiversity outcomes. By defining the trade-off frontier between carbon and biodiversity outcomes, we discover that the biodiversity benefits of REDD can be doubled while only incurring an 8% reduction in carbon protection. We propose a simple conservation metric which can be integrated into the REDD mechanism to provide near optimal increases in biodiversity protection.

**Conclusions**

The REDD mechanism may soon become a powerful funder of forest conservation. Our results show that this could deliver significant benefits for the conservation of forest biodiversity, and if these benefits are incorporated into the REDD mechanism, they could be increased very cost-effectively.

**Keywords:** carbon, biodiversity conservation, deforestation, REDD, trade-offs

**Verdade Luciano, Martinelli Luiz****The impacts of biofuel on biodiversity in Brazil**

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Symposium S06, Biofuels and Biodiversity

Brazil is the second largest producer of ethanol in the world. Last year this country produced a billion liters of ethanol from almost 9 million hectares of sugar cane. Estimates made by the Brazilian Government indicate that the area covered with sugar cane may reach 14 million hectares by 2016. Our main goal in this study is to address the possible effects of the sugar cane expansion on wildlife in Brazil.

We surveyed mammals and birds in native forest remnants, Eucalyptus plantations, sugar cane plantations and exotic pastures of south-eastern Brazil and also surveyed land use change directly or indirectly related with biofuel production in the last decade in this country.

Approximately 2/3 of the original bird and mammal communities can still be found in agricultural landscapes of southeastern Brazil, mostly generalist species using the landscape as a whole not only the remaining native forest fragments, which can be considered as an evidence of evolutionary adaptation to anthropogenic pressures. The abundance of most species is apparently considerably smaller than during pre-European colonization. Rodents are less diverse but more abundant in sugar cane plantations, whereas birds are more diverse in native forest and more abundant in exotic pastures. Rodents in sugar cane plantations are potential Hantaviruses hosts which can become a public health problem of major concern. Forest fragments are locally protected by law but enforcement is required to achieve legal levels.

Conclusions: The following aspects should be prioritized by Brazilian scientists and managers: a) The possible spread of diseases by rodents associated with sugar cane plantations; b) The evolutionary adaptation processes related with the use of anthropogenic areas by wildlife, c) The population decline of the remaining species of vertebrates due to agriculture expansion, and d) The enforcement necessary to achieve environmental law requirements

**Keywords:** biofuel, wildlife, Neotropics, sugar cane, animal conservation

**Verheyen Erik****Exploration of biodiversity patterns and evolutionary histories of central African freshwater fish faunas**

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Symposium S12, Genetic drivers of freshwater biodiversity

**Background and goal of study**

Since the early 1990's African freshwater fishes have been used as models in phylogenetic and phylogeographic studies to explain the origin, speciation and spreading of these faunas across the African water drainage systems. This review illustrates how such studies have gradually become more convincing when larger taxonomic sampling, denser geographical sampling and increasing sample sizes became possible.

**Materials and Methods**

The compilation of improved data sets, combined with increasingly sophisticated methods for data analyses has not only allowed to fully explore 'traditional' topics addressed in phylogeographic studies, but also to address new and more complex issues. Relatively little is known about the evolutionary response of freshwater species to global climate change because time scales are often too long to be directly studied. Combined with paleoclimatic information, the molecular phylogenetic approach allows shedding light on the effects of past global climatic induced changes on the dynamics of diversification, the origin of adaptive radiations and the tempo and mode of speciation events in species rich genera.

**Results and discussion**

Evolutionary responses that can be detected by a molecular phylogenetic approach appear to coincide with climate driven environmental changes and to be concentrated within narrow periods of time. Both the haplochromine cichlids and the species-rich mochochid genus *Synodontis* occur in the African Great Lakes and surrounding rivers. Recent studies on Cichlidae and new data on *Synodontis* suggest that

effects of past climate-induced environmental changes on these freshwater fish's assemblages can be reconstructed by detailed phylogeographies.

### Conclusions

The number of reported cases of introgression events, sometimes suggestive of speciation events resulting from environmentally driven (low population densities) hybridization between undoubtedly valid biological species increases with the number of studies. It remains to be tested whether these seemingly environmentally driven events occurred simultaneously across different fish groups and ecological guilds.

**Keywords:** phylogeny, phylogeography, Cichlidae, Mochochidae, paleoclimate

**Verleyen Elie**, Van Der Gucht Katleen, Martens Koen, De Meester Luc, Vyverman Wim

### Patterns in microbial diversity and community structure at multiple spatial scales

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Symposium S12, Genetic drivers of freshwater biodiversity

### Background and goal of study

Microbial communities constitute the basis of the food web in aquatic environments and catalyze important biogeochemical processes. Understanding the mechanisms that govern their distribution is thus of utmost importance.

### Materials and Methods

In recent years, we studied the structure and diversity of microbial communities in lakes and ponds from local to continental scale (meters to thousands of km) using Denaturing Gradient Gel Electrophoresis and clone library analysis on the small subunit rDNA gene for bacterioplankton and using microscopy for diatoms.

### Results and discussion

Our results show that regional factors (dispersal limitation and mass effects) have little influence on bacterioplankton community structure and diversity over a wide range of spatial scales, regardless of the isolation of their habitat. Taxon sorting by local environmental factors in bacterioplankton communities appeared very important, and is, among others, related to eutrophication and the clear-water and turbid alternative stable states in shallow lakes. These findings are in line with prediction from the high dispersal capabilities generally assumed for microorganisms, but are in contrast to distribution patterns in diatoms and macroscopic organisms. In diatoms, the diversity and taxonomic turnover are structured by both regional and local environmental factors, which is consistent with predictions from the theory of island biogeography and likely underlie the strong provincialism and endemism observed in the relatively isolated floras in the Southern Hemisphere.

### Conclusions

There are clear differences between the distribution patterns in diatoms and bacteria. The observed differences will be discussed in the light of their life cycle characteristics (e.g. sexual versus asexual, formation of resting spores), evolutionary history, and ecological niche characteristics.

**Keywords:** microorganisms, metacommunities, biogeography, endemism, ubiquity

**Vodouhe Raymond**, Grum Mikkel, Smale Melinda, Sidibe Amadou, Balma Didier, Danjimo Baina

### Diversity Field Fora: A participatory approach to management of crop diversity for greater resilience and sustainability in West and Central Africa

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Symposium S14, Biodiversity and agricultural sustainability: from assessment to adaptive management

### Background and Goal of Study

In the harsh environment of the Sahelian zones of West Africa, local populations depend on crop genetic diversity for food, health and income generation. Methods and practices that maintain and enhance sustainably crop genetic diversity in the ever changing climate is key to local community livelihood. This paper presents and discusses both traditional practices and modern techniques that ensure long term conservation of plant genetic resources on farm.

**Materials and Methods**

Diversity Field Fora (DFF) approach is used in Burkina Faso, Mali and Niger from 2003 to 2007 to test and select suitable cultivars/varieties in farmers field conditions. In the project sites farmers' research teams made of men and women made decision on crop species to be tested and criteria to be used for selection. Weekly field visits and group meetings allowed farmers to exchange on variety performance. Project impact on local communities is assessed using structured socio economic questionnaires. Local or regional seeds fairs are organized annually to disclose crop genetic diversity, quality and yielding potential of cultivars/landraces conserved by farmers.

**Results and Discussion**

Using DFF, farmers augmented and better conserved their crop genetic diversity; developed new skills, strengthened their social cohesion and raised awareness on policy issues of importance to genetic resources management. An impact analysis conducted in Mali indicates that participation in DFF led to higher millet and sorghum yields, as well as a larger number of unique attributes in millet and sorghum varieties stocked as seed. Traditional seed system is strengthened and some farmers' groups are transformed into sorghum and millet seed multiplication associations that supply 70 to 80% of local communities' needs.

**Conclusion**

DFF brought together farmers to acquire new skills, promote their innovations and strengthen their self confidence. It contributes to effective paradigm change where local communities are empowered to leverage their crop diversity for enhanced livelihood strategies.

Keywords: Agrobiodiversity, landraces, cultivars, selection, livelihood

**Vörösmarty Charles****Humans Transforming the Global Water System: What Does This Mean for Nature?**

The City College of New York, City University of New York, Civil Engineering, USA

Symposium S03, The Freshwater Biodiversity Crisis: a global threat to ecosystems and people

On this Blue Planet, water is arguably the essential ingredient linking the physics, chemistry, and biology of the Earth system. In addition to greenhouse warming and concerns about an "accelerated" hydrologic cycle, many other anthropogenic factors are at work, often quite directly, changing the state of the inland aquatic ecosystems, the services they provide and, in turn, the sustainability of the global water resource base. Prominent among these direct agents of change are widespread land cover change, urbanization, industrialization, plus a host of hydraulic engineering schemes -like reservoir construction, irrigation, and interbasin transfers- all designed to optimize the use of water by humans. All yield impacts, both positive and negative, on water resources. And, as humans struggle with tightly-linked strategic imperatives on food and energy security, economic development, and carbon mitigation that will serve a population moving toward 9-10B, the collective significance of transformations of so basic an element of the Earth system remains unknown. As they have for millennia, humans will struggle to stabilize and make available adequate water in the face of a highly capricious climate, failed governance, mismanagement, overuse and depletion, biodiversity loss, and pollution. This presentation will provide an overview on the nature and scope of these challenges together with a synopsis of joint work between the Global Water System Project and DIVERSITAS, aimed at developing indicators of threats to inland freshwaters from both an ecosystem health and human water security perspective.

**Keywords:** hydrologic, anthropologic, industrialization, sustainability, transformation

**Wijffels Rene H.****Microalgae for production of bulk chemicals and biofuels**

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Symposium S06, Biofuels and Biodiversity

Biodiesel derived from oil crops is a potential renewable and carbon neutral alternative to petroleum fuels. Microalgae, like higher plants, produce storage lipids in the form of triacylglycerols (TAGs) which can be used to synthesize fatty acid methyl esters (a substitute for fossil-derived diesel fuel).

Microalgae represent a very attractive alternative compared to terrestrial oleaginous species because their productivity is much higher and it does not compete for land suitable for agricultural irrigation or consumption by humans or animals, providing therefore food security.

To date, commercial application of microalgae has concentrated on compounds that have a very high value per kilo (e.g. carotenoids). To be a feasible source for biodiesel, the current price for microalgae production needs to be reduced by two orders of magnitude. In addition, the scale of production of lipids from microalgae would need to be three orders of magnitude greater than the scale currently possible for high-value compounds. These ambitious goals are feasible because the potential productivity of microalgae is tenfold greater than that of

agricultural crops. We executed a feasibility study of producing microalgae and compared 3 production technologies: open pond systems, tubular system and a flat panel photobioreactor.

The analysis was based on state-of-the-art technology for the solar conditions in the Netherlands. Estimations were conservative, which means that for reaching estimated productivities there is no need to develop systems or processes further than is now possible. Sensitivity analysis showed that production costs can be reduced significantly. If this was combined with the use of the microalgae produced in other applications (a biorefinery approach) the commercial production of microalgae could become a realistic option for the biofuel market.

**Keywords:** microalgae, biodiesel, storage lipids, carotenoids, production technology

## **Wilshusen Peter**

### **Conservation Futures: A review of the political and normative dimensions of biodiversity conservation initiatives**

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Symposium S05, Biodiversity Change and Human Well-being

#### **Background and goal of study**

A considerable amount of scholarly writing has emerged over the past decade that critiques biodiversity conservation initiatives at diverse scales. This literature highlights complex and interrelated social, political, and cultural impacts of conservation efforts worldwide. In general, critiques identify disparities in power relationships stemming from discursive, institutional, and material dynamics but do not prescribe specific policy alternatives that might address gaps in power or shortcomings in biodiversity protection programs. This presentation will examine the normative and political dimensions of critiques of conservation to assess whether or not they implicitly offer building blocks for coherent and plausible responses for biodiversity planning and policy-making.

#### **Materials and methods**

This project comprises an extensive review and analysis of social scientific critiques of biodiversity conservation initiatives as found in relevant peer-reviewed literatures.

Results and discussion will focus on the philosophical and normative assumptions underlying critiques of conservation and will identify trends in the content and style of argument.

Conclusions will center on the extent to which critical social scientific perspectives on biodiversity conservation represent a radical deconstruction that precludes reform. It proposes that, even though deep critiques present considerable challenges to conservation planners, critical social theory may offer elements for a socially just approach to biodiversity conservation.

**Keywords:** community, conservation, social theory, critique, justice

## **Wirth Christian, Scherer-Lorenzen Michael**

### **The functional role of tree species diversity: Changing patterns under climate change?**

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Symposium S17, The role of forest biodiversity for ecosystem processes and services

#### **Background and Goals**

Current research on the role of tree species diversity for ecosystem processes and the delivery of ecological services is based on two distinct, but complementary approaches: (i) comparative studies in established stands of differing tree diversity, and (ii) experiments manipulating tree species diversity and composition. Direct experimental manipulations of climatic factors along gradients of tree diversity do not exist, although some newer experiments mimic climate-driven non-random extinction scenarios. So far we can only indirectly infer from the existing studies whether the diversity – functioning relationship will be affected by climate change.

#### **Results**

Since most tree diversity experiments are still very young, evidence for tree diversity effects remains scarce. Nevertheless, some studies report of enhanced tree growth and nutrient cycling in mixtures compared with monocultures, although opposing results have also been documented. Similarly, silvicultural trials as well as comparative studies showed positive, negative or species-specific diversity effects. The increased availability of large scale inventories and tree traits related to bioclimatic range limits allows one to assess a community's

propensity to compositional shifts. Studies analyzing differential species-specific responses in mixed forests during extreme years suggest that compositional shifts have the potential to strongly affect ecosystem functioning.

### Conclusions

A clear general view of the functional role of tree diversity in forest ecosystems has not emerged so far. The presence of certain functional traits, i.e. species identity, is certainly a major driver of ecosystem functioning. Yet even more difficult to answer is the question about impacts of climate change on diversity – functioning relationships. With changing species abundances, the functional trait space of forests will change, making climate-induced effects on ecosystem functioning very plausible.

**Keywords:** biodiversity, climate change, ecosystem functioning, forest, experiment

Wise Russell, **Reyers Belinda**, Busch Jonah, Shaw Rebecca, Hannah Lee

### Determining the costs of conservation responses to climate change: case studies from global biodiversity hotspots

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Symposium S01, Climate Change and Biodiversity: Adaptive Management in the Face of Uncertainty

Climate change will severely challenge contemporary conservation goals and strategies. Thus, we need to change the way we allocate conservation resources for planning, adaptive management and policy in order to increase the likelihood of sustaining biodiversity and ecosystem services. However, little is known about the costs and implementation context of conservation responses to climate change. We investigate a set of conservation responses to adapt to a range of predicted climate-change impacts in three global biodiversity hotspots: the Cape Floristic Region (CFR), Madagascar and California. These responses include: protected area expansion (on and off reserve) and seed banking for one family of plants, the Proteaceae, in the CFR; targeted restoration of forest and reductions of deforestation in Madagascar; and multiple responses in a protected area in California including land acquisition, reserve management, captive breeding, seed banking, off-reserve management, contracts, and biodiversity translocations. The costs of these responses range widely from \$3.3M yr<sup>-1</sup> to manage one protected area in California over 30 years to \$24.6M yr<sup>-1</sup> for off-reserve management of the Proteaceae family in the CFR over 50 years. These costs are much higher than existing budgets. We propose that if, like other adaptation responses, they were examined in relation to their social benefits (e.g., mitigation co-benefits), the planning environment, and partnerships for building sustainable futures, then the costs themselves become less of a barrier to implementation. We highlight funding sources for future leverage and action.

**Keywords:** off reserve, seed banking, translocations, dispersal, adaptation

### Witt Arne

#### Biofuels and invasive species from an African perspective

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Symposium S06, Biofuels and Biodiversity

Biofuel production is expanding rapidly throughout the world, driven by predicted high crude oil prices, the desire of countries to be energy independent, and concerns about climate change. Peripheral anticipated benefits, especially in Africa, include rural development, with new and profitable land-use practices providing better opportunities and long-term security for farmers and workers. However, many of the species being promoted for biofuel production possess the same attributes of invasive plants such as rapid growth rate, high yields, low water and maintenance costs, an ability to grow in a wide range of habitats under a range of climatic regimes, and ability to coppice. Many of the proposed first- and second-generation biofuels are already invasive on the African continent and attempts to introduce higher yielding varieties and genetically modified species may exacerbate the problem. The commercialization of invasive plants for feedstock may create perverse incentives which will contribute to their spread and inhibit potential future management to the detriment of biodiversity, food security and scarce water resources. Unless management plans can be put in place that can contain the spread of invasive or potentially invasive biofuel crops in Africa, the costs will outweigh the potential benefits. It is suggested that in the case of potential second-generation biofuel crops, that are known to be invasive, host-specific biocontrol agents be introduced to reduce the reproductive potential of these species. This is clearly not an option for 'first-generation' biofuel crops where the seeds are the source of oil. In summary, it is imperative that authorities undertake a pest risk analysis of all species being promoted for biofuel production in addition to a cost-benefit analysis. Africa can ill afford the further introduction and spread of invasive plant species.

**Keywords:** biofuels, invasive species, rural development, coppice, land-use

**Woodward Ian****The future for global plant diversity – impacts of changing climate and carbon dioxide concentration**

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Symposium S19, Biodiversity and Carbon – Towards a research programme to define linkages

**Background and goal of study**

The IPCC warns of severe losses of biodiversity by the middle of the current century. This conclusion is based on work that investigated the impacts of changing climate but ignored any direct effects that rising CO<sub>2</sub> may exert on plants. The goal of this work was to interrogate the IPCC conclusion but using a mechanistic understanding of the relationship between biodiversity and net primary productivity.

**Materials and Methods**

Using new understanding of relationships between plant productivity and species diversity it was possible to mechanistically model the projected impacts of climate change and elevated CO<sub>2</sub> on species diversity.

**Conclusions**

Rising CO<sub>2</sub> concentrations could diminish or even invert the negative impacts of a warming climate on plant diversity. However it is most likely that there will be an increased establishment of invasive species that would place native species at increased risk of survival. Elevated CO<sub>2</sub> therefore might create new opportunities for some species, and reduce the success and persistence of others.

**Keywords:** mechanistic models, SDGVM, photosynthesis, carbon allocation, invasive alien species

**Wunder Sven****Can environmental services from complex landscapes be sold?**

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Symposium S15, Research for adaptive management of biodiversity-rich tropical landscape mosaics

Ecosystem services are often seen as a new panacea for conservation: service beneficiaries willing to pay for services provided constitute a pathway for conservation finance, but also for providing direct economic incentives to landholders that promise to be effective in changing on-the-ground behaviour. However, to what extent can such services actually be packaged and sold, in ways that make a real difference for the scope of conservation? First, ecosystem services need to be threatened, and have the nature of 'externalities' (off-farm benefits), in order to be eligible for payment mechanisms. Second, how to design an integrated incentive package for different services provided to often different users? This is important in moving towards successful implementation, involving both biophysical and economic challenges. Service provision may be synergetic at the general level, but maximizing a landscape's provision of different services may involve important partial trade-offs between services, in terms of spatial priorities and the type of preferred interventions. Once biophysical priorities have been mapped, the economic strategy of how to possibly sell complex services needs to be thought through: is bundling, layering, or piggy-backing between services the best option? This presentation reviews practical experiences from combining different services, including biodiversity conservation, in payment strategies in different parts of the world. It is concluded that selling different services to different users in private, voluntary conservation deals is often constrained by biophysical service trade-offs, by high transaction costs of dealing with different buyers, and by the buyer incentives to free-ride on the provision of non-exclusive (e.g. global) services. Use of government-financed PES schemes, where services can be layered while payments may come from tax payers or service users without being fully voluntary, should thus also be improved.

**Keywords:** Payments for environmental services, conservation, economic incentives, spatial analysis, externalities

**Yahara Tetsukazu****Challenges to develop biodiversity observation networks in ecosystem, species and gene levels**

Kyushu University, Department of Biology, Japan

Symposium S07, Analysis and forecasting of biodiversity and ecosystem processes: a contribution to GEO BON

Biodiversity changes including deterioration and loss are on-going in every level of ecosystem, species, and gene. However, observations to quantify those biodiversity changes in the global scale are still in an infant stage. Recently, the Group on Earth Observations Biodiversity Observation Network (GEO BON) was launched to improve this situation. The aim of GEO BON is not to carry out new observation projects but to organize a global network for synthesizing available data and illustrating how rapidly biodiversity is being lost in the global scale. It is assumed that there is no general shortage of biodiversity data and the difficulty to be overcome is to create systems whereby available

data can be combined. However, there are hardly any attempts to combine well-replicated assessments of the biodiversity in all levels of ecosystem, species, and gene with assessments of ecosystem processes in real landscapes. The goal of this symposium is to organize researchers promoting leading projects of biodiversity observations, promote discussion about how to merge biodiversity observations on states and processes in ecosystem, species, and gene levels, and draft a position paper on how to improve our situation and how to arrive at a wide-spanning network of such research attempts.

In my talk, I will introduce our challenge to develop biodiversity observation network in Japan (JBON) by integrating monitoring activities in the level of ecosystem, species, and gene in Japan such as Japanese Long Term Ecological Research Network (JaLTER), monitoring network for Japanese vascular plants RDB, and Actions for Genetic Diversity Assessment (AGenDA).

**Keywords:** ecosystem, species, gene, biodiversity observation network, GEO BON

### **Zhou Jizhong**

#### **Metagenomic analysis of the feedback responses of soil microbial communities to elevated CO<sub>2</sub>**

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Symposium S17, The role of forest biodiversity for ecosystem processes and services

Understanding the responses and mechanisms of biological communities to elevated atmosphere carbon dioxide (eCO<sub>2</sub>) is a central issue in ecology and for society. Although the fertilization effects of eCO<sub>2</sub> on aboveground plants are well documented, its influences on belowground microbial communities are poorly understood. The responses of belowground microbial communities to eCO<sub>2</sub> will critically influence whether and how much the fertilization effects will lead to C loss or sequestration in terrestrial ecosystems. We used high throughput metagenomics technologies, such as GeoChip and pyrosequencing, to address the following questions: (i) Does elevated [CO<sub>2</sub>] affect the composition of soil microbial communities? (ii) Does elevated [CO<sub>2</sub>] affect soil microbial functional genes likely to influence carbon and nitrogen cycles under elevated CO<sub>2</sub>? Our results show that eCO<sub>2</sub> significantly altered the genetic and functional structure of the belowground microbial community in a grassland ecosystem in eastern Minnesota after 10 years of field exposure to eCO<sub>2</sub>. Soil community responses are consistent with and help explain ecosystem responses involving soil carbon and nitrogen content and plant productivity. Specifically, while the functional genes involved in degrading labile carbon are significantly increased under eCO<sub>2</sub>, the genes for decomposing recalcitrant carbon remain unchanged. The genes involved in fixing carbon and nitrogen and releasing phosphorus are also significantly increased. The results suggest that elevated [CO<sub>2</sub>] has significant impacts on relative abundance, composition and potential functions of soil microbial communities, and they could have important implications for the feedback responses of ecosystems to atmospheric CO<sub>2</sub> and hence to the global climate change modeling needed for reliable prediction of future atmospheric CO<sub>2</sub>.

**Keywords:** Global changes, Microbial diversity, GeoChip, Metagenomics, Pyrosequencing

# Orals

**Achigan Dako Enoch Gbenato**, Ndanikou Sognigbe**Estimating the diversity of traditional vegetables in socio linguistic groups in Benin**

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Contributed oral session O3, Agrobiodiversity

Conservation of biodiversity research has tended to focus on wild tree species and natural/semi-natural habitats, overlooking the great diversity of plant resources used for vegetable purposes. In Benin 19 socio linguistic groups were surveyed from September 2006 to February 2008 in the three major phytogeographic regions known as the Guinean zone, the Sudano-Guinean zone and the Sudanian zone. The surveyed sociolinguistic groups include Yoruba-Nagot, Fon, Bariba, Adja, Kotofon, and Ditammari. The focus groups were supplemented with field visits and conducted in 49 villages with the participation of at least 20 community members in which both men and women and different age groups were represented. The species richness at country level and in phytogeographical regions was estimated using species accumulation curves. In total 245 species are used as vegetable resources all over the country. These species belong to 62 plant families. Most frequently used families include *Amaranthaceae*, *Asteraceae*, *Cucurbitaceae*, *Leguminosae*. About 70% of collected vegetables are wild resources and only 19% were clearly under cultivation. In most cases, herbs were the most widely consumed life form by surveyed communities. No significant difference in life form prevalence was observed among phytogeographical regions. Frequently consumed wild vegetables (listed in more than 10 villages) include *Adansonia digitata*, *Bombax costatum*, *Senna occidentalis*, *Cissus populnea*, *Corchorus tridens*, *Crassocephalum rubens*, *Grewia mollis*, *Launaea taraxacifolia*, *Lippia multiflora*, *Sesamum indicum*, *Stachytarpheta indica*, *Sterculia tragacantha*, and . The country wide inventory of traditional vegetables is a grassroots activity on which domestication trials and conservation strategies could be developed to insure the sustainable use of local plant resources.

**Keywords:** Diversity, Vegetables, Sociolinguistic groups, Phytoregions, Benin**Aguilar Ramiro****Reproductive and genetic consequences of habitat fragmentation in plant populations: What do we know after two decades of research?**

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Contributed oral session O6, Biological diversification

The loss and fragmentation of natural habitats by human activities are pervasive phenomena in terrestrial ecosystems across the Earth and the main current driving forces behind biodiversity loss. Fragmentation studies in plant populations have mostly focused on sexual plant reproductive dynamics. More recently, plant population genetic parameters have also been thoroughly investigated in fragmented habitats. By means of meta-analyses we reviewed the results of 20 years of fragmentation studies around the world and tested whether reproductive output and genetic diversity decreases in fragmented habitats, and whether fragmentation has differential effects depending on certain life history and ecological traits of plants. We also tested whether certain methodological approaches used by authors influence the ability to detect fragmentation effects. Overall, fragmentation has large and negative effects on pollination, plant reproduction, genetic diversity and outcrossing rates but no effects on inbreeding coefficients. The mating system of plants, which reflects both the degree of dependence on pollinator mutualism and also the distribution of genetic diversity within and among populations, explained most of the variation among the species' effect sizes. Outcrossing, self-incompatible plants showed strong negative fragmentation effects on reproduction and allelic richness. The rarity status of plants also determined differential susceptibility to genetic erosion, where common and recently rare plants were more negatively affected. Higher inbreeding coefficients in fragmented habitats were only observed in studies analyzing progenies. The time elapsed in fragmentation conditions significantly influenced the results. Our results suggest that fragmentation is shifting mating patterns towards increased selfing. We conclude that animal-pollinated self-incompatible plants are exceptionally vulnerable to fragmentation as a consequence of both, ecological and genetic mechanisms.

**Keywords:** Habitat fragmentation, plant mating system, pollination, genetic diversity, meta-analysis**Akegbejo-Samsons Yemi****Sustainable aquaculture and fisheries production under extreme events: Will Africa be able to cope?**

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Contributed oral session O12, Drivers of biodiversity 2

Several research reports have consistently noted the vulnerability of the African continent to the impacts of climate change. Africa's vulnerability arises from a combination of physical and social processes and represents the interface between exposure to climatic threats interacting with other non-climatic threats, and the capacity of the threatened systems to cope with those threats. Because of increasing concerns about water quality for human use and ecosystem sustainability, there is an emerging need to assess the impacts of climate change

on the quality of inland water resources (fish and fisheries) in Africa. The objective of this study is to provide current baseline information on the coping strategies and current preparedness of the sub-Saharan region with a focus on experiences, lessons and future challenges of sustainable aquaculture and fish production under extreme events. In this presentation, the potential impact of climate change on aquatic sites and site-adapted fish resources will be discussed within the framework of aquatic habitat classification. The methods used include a quantitative assessment of current actions and programmes of some countries in Africa. The data was aggregated along the awareness of the impacts of extreme events on aquatic resources, mitigation and management etc. The study shows that climate change-induced events are considered to have a serious effect upon livelihood activities. Results show that most African nations do not have the economic and scientific resources to tackle extreme event cases. Climate change represents a potentially detrimental factor to fish-dependent communities as extremely high rainfalls or severe droughts may cause changes in fish and human habitats. This paper concluded by presenting the impact of climate change on aquaculture and fisheries and examines what African governments need to put in place to predict changes as well as mitigating measures for fishing communities.

**Keywords:** aquaculture, diversity, sustainability, extreme events, Africa

**Alkemade Rob,** Bakkenes Michel, Van Oorschot Mark, Lera Miles, Ben Ten Brink

**Consequences of land use scenarios for global biodiversity**

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Contributed oral session O10, Projecting 21st century biodiversity change

**Background and goal**

Land use change is globally one of the major factors affecting biodiversity. The increasing human population and developing economy will increase the demand for food and other agricultural products and therefore a growing demand for land can be expected. This will have its impact on biodiversity. The aim of this paper is to explore sustainable land use options that provide sufficient goods and services for humans and simultaneously preserve as much biodiversity as possible.

**Materials and methods**

The options for sustainable land use will be explored using a combination of the IMAGE model for integrated assessments and the GLOBIO3 model. The latter model is used to assess the consequences of multiple drivers for biodiversity, in terms of mean species abundance of originally occurring species (MSA), and includes cause-effect relationships for land-use change, climate change, infrastructure development and pollution.

**Results and discussion**

In all scenarios biodiversity, in terms of MSA, will decrease. The spatial distribution of the changes, however, differs among scenarios. Intensifying agriculture leads to a lower land demand, but will deplete biodiversity in those areas considerably, whereas in scenarios with less intensive land use the demand for land is higher and local biodiversity, including its services, remains higher in those areas.

**Conclusions**

The IMAGE – GLOBIO combination provides insight in the global consequences of different options of land use.

**Keywords:** biodiversity, MSA, land use, GLOBIO, scenarios

**Allan Eric,** Weisser Wolfgang, Markus Fischer, Bernhard Schmid

**Generalising the biodiversity - ecosystem functioning relationship based on 520 measures from a single experiment**

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Contributed oral session O7, Biodiversity and ecosystem functioning 1

The concern about the increasing global loss of biodiversity has prompted a large number of studies to evaluate the relationship between species richness and ecosystem functioning. Recently, reviews and meta-analyses have attempted to find general patterns emerging across many different studies. As an alternative approach, we present a meta-analysis of 520 variables measured in a single diversity experiment involving grasslands (the Jena Experiment, Germany). This is the first time that so many processes have been measured in a single experiment, and this approach gives new insights into biodiversity effects not found in previous syntheses. Measures of carbon were affected more strongly by species richness than measures of nutrients, suggesting that declines in species richness will have a stronger negative effect on the carbon cycle than on the nitrogen cycle. This is due to different effects of different components of biodiversity on nitrogen measures: whilst legumes had a strong positive effect on such measures, grasses had a negative effect. Increasing species richness had

strong positive effects on the species diversity of all higher trophic levels, but fewer on carnivores than on herbivores. The effects of biodiversity were greater and more often significant above- than belowground; legume effects were also greater aboveground. We interpret these results by making general predictions on the effects of the loss of biodiversity on ecosystem functioning.

**Keywords:** biodiversity experiments, meta-analysis, functional groups, biogeochemical cycles, multitrophic

### **Altamirano Adison**

#### **Prioritizing conservation areas in temperate ecosystems of Chile: Do target areas change in the face of climate change?**

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Contributed oral session O8, Conservation planning 1

The temperate forests of Chile have been included among the most threatened eco-regions in the world due to the high degree of endemism and the presence of monotypic genera. In this study, we develop empirical models to investigate present and future spatial patterns of woody species richness in temperate forests of south-central Chile. Our aims are both to increase understanding of species richness patterns and to inform forest conservation strategies. Our data were obtained at multiple spatial scales, including field sampling, climate data, elevation and topography data, and land-cover and spectrally derived variables from satellite sensor imagery. Climatic and land-cover variables most effectively accounted for tree species richness variability, while only weak relationships were found between explanatory variables and shrub species richness. The best models were used to predict tree species richness for 2050, using data from the Hadley Centre's HadCM3. Current protected areas are located far from the areas of highest tree conservation value and our models suggest that this trend will continue. We therefore suggest that current conservation strategies are insufficient, a trend likely to be repeated across many other areas. We propose that the current network of protected areas should be increased, prioritizing sites of both current and future importance to increase the effectiveness of the national protected areas system. In this way, target sites for conservation can also be chosen to bring other benefits, such as improved water supply to populated areas.

**Keywords:** Biodiversity, Hotspot, Natural Protected Areas, Spatial modelling, Maule region

### **Alvarez-Filip Lorenzo, Dulvy Nicholas, Gill Jennifer, Côté Isabelle, Watkinson Andrew**

#### **Region wide declines in the architectural complexity of Caribbean coral reefs**

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Contributed oral session O5, Drivers of biodiversity 1

#### **Background and goal of study**

Coral reefs are among the most biodiverse ecosystems in the world, in part because of the high degree of architectural complexity of reef-building corals, which provide shelter and resources for a very wide range of organisms. In the Caribbean, recent region-wide declines in hard coral cover have been well documented but any concomitant changes in the architectural complexity of Caribbean reefs are unknown. Here we provide the first region-wide analysis of changes in reef architectural complexity.

#### **Methods**

We collated and analysed a database of nearly 500 surveys across 200 reefs between 1969 and 2008.

#### **Results and discussion**

The architectural complexity of Caribbean reefs has declined by c. 50% over the last 40 years. The greatest rate of loss occurred between 1969 and 1985, followed by stasis until 1998 and then a resumption of the decline in complexity to the present. Rates of loss are similar on shallow (< 6 m), mid-water (6 - 20 m) and deep (> 20 m) reefs. The temporal pattern of declining architecture coincides with key events in the recent history of the Caribbean; the well-documented loss of structurally complex *Acropora* corals, the mass mortality of the grazing urchin *Diadema antillarum*, and the 1998 ENSO-induced world-wide coral bleaching event. The consistently low estimates of current architectural complexity suggest regional-scale degradation and homogenisation of reef structure.

#### **Conclusion**

The widespread loss of complexity on reefs is likely to have serious consequences for reef biodiversity, ecosystem functioning and associated environmental services, such as coastal protection and fisheries productivity. This highlights the need for a region-wide strategy to reverse coral declines and to facilitate the maintenance and recovery of structurally-dominant corals in the Caribbean.

**Keywords:** Coral reefs, Ecosystem degradation, Foundation species, Habitat complexity, Vulnerability

**Ameca y Juárez Eric Isai**, Mcinnes Lynsey, Purvis Andy**Landscape impermeability in amphibians: understanding current drivers shaping distributional limits**

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Contributed oral session O5, Drivers of biodiversity 1

**Background and goal of study**

Several studies attempt to predict future species distributions but few strive to determine where and why species' distributions end. A better understanding of the factors influencing species range limits will help to identify which regions and species are prone to be threatened by effects of the ongoing climate crisis and hence, to allocate conservation efforts efficiently.

**Materials and methods**

In this study, we use a global database of amphibian ranges and a suite of environmental datasets to determine the main factors shaping distributional limits in amphibians. We do this by using a newly-developed measure quantifying the density of range edges in an area. The measure, landscape impermeability, is calculated as the proportion of resident species whose ranges end in an area.

**Results and discussion**

In a global analysis, high landscape impermeability for amphibians is correlated with areas of high habitat heterogeneity and topographic complexity, becoming higher when combined with low levels of evapotranspiration. However, these patterns cannot be taken as a surrogate for the regional scale. Within biomes, landscape impermeability is highly due to the low evapotranspiration in arid areas (deserts) and this relationship becomes stronger in dry-cold areas (boreal and coniferous forest). In wet and warm biomes (moist forests), impermeability is high due to the high habitat diversity and topographic complexity of the environment even in the presence of optimal input of energy in the environment. In contrast to other regions, high human density in mixed forests correlates with low landscape impermeability and hence may facilitate amphibian dispersal.

**Conclusion**

Our results are a first step to accurately detecting regions and species most at risk under future climate vicissitudes and human pressures.

**Keywords:** range limits, species, amphibians, energy availability, habitat heterogeneity

**Andrade-Morravey Monica****Land cover changes and emerging infectious diseases in Southeastern Brazil: Brazilian Purpuric Fever, Brazilian Spotted Fever and Hantaviruses**

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Contributed oral session O17, Conservation planning 2

In the present study we examine the historic pattern of land cover changes and temporal and spatial distribution of three different emerging infectious diseases reported in the last three decades, in Southeastern Brazil. Brazilian Purpuric Fever emerged (BPF) as a fatal pediatric disease in Brazil in the 1980s characterized by epidemic purpura fulminans preceded by purulent conjunctivitis caused by *Haemophilus influenzae* biogroup *aegyptius* (*H. aegyptius*) bacteremia. Brazilian Spotted Fever (BSF) is an infectious disease caused by the bacterium *Rickettsia rickettsii*, and is transmitted by *Amblyomma* sp. ticks. It was reported for the first time in Brazil by the São Paulo State in 1929 and re-emerged in the 1980s. Hantavirus pulmonary syndrome (HPS) is a deadly or a high mortality (50%) disease transmitted by infected wild rodents through urine, droppings, or saliva. It was first recognized in 1993 in São Paulo State and since then it has been identified throughout Brazil. The current Cerrado and Mata Atlântica vegetation in São Paulo state (less than 7% of the original cover) has been replaced mostly by pasture, sugarcane, soybean, perennial crops and urban zones. Changes in land use around natural areas bring their own consequences to the ecosystem and can be responsible for the emergence of those diseases, through different mechanisms. For BPF there was a microbial adaptation; for Brazilian Spotted Fever and Hantaviruses (re-)emergence can be an effect of forest fragmentation and ecosystems alteration within or close to towns and frequently sites for human leisure activities. Land-use and land-cover changes have led to an ecological disequilibrium due to a loss of biodiversity (local extinction of large predators) and have possibly increased the transmission of those diseases in that area.

**Keywords:** emerging infectious diseases, Land cover changes, Brazilian Purpuric Fever, Brazilian Spotted Fever, Hantaviruses

**Andriamparany Rivolala, Elmqvist Thomas, Bodin Örjan****Temporal dynamics of plant pollinator networks in semi- arid agricultural landscapes of southern Madagascar: Patterns of drought effect and responses seen on the plant pollinator community**

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Contributed oral session O12, Drivers of biodiversity 2

**Background and Goal of Study**

The pollination service is important for crop production in agricultural landscapes. The management of the pollination service in the time of drought justifies the identification of key ecosystem providers and the understanding of response and diverse stabilizing mechanisms. Through an analysis of plant pollinator network temporal dynamic, we have investigated several drought effects and explored emerging responses of the plant pollinator community.

**Materials and Methods**

Our study has focused on 15 sacred forest patches in the semi arid agricultural and fragmented landscape of Ambovombe, a region suffering from lack of rainfall, in southern Madagascar. Plant pollinator networks are sampled by observing, by identifying, and by noting interactions between floral visitors and plants around patches. We have compared species richness, community composition, network linkage and a list of well connected species recorded from 3 seasonal studies of 2005, of 2006, the year of drought, and of 2007.

**Results and discussions**

In 2007, most of the species (more than 90%) and linkages (more than 60%) removed because of the drought reappeared on the plant pollinator network. Those facts indicate community recovery and network tolerance. After the drought, 8 weakly connected pollinator species of drought became the ten well connected pollinators, this pattern suggests response diversity. Drought affects floral visitor species richness, plant species richness, species composition, linkages between floral visitors and plants, well connected pollinator species. To cope with drought, responses emerge from plant pollinator networks through community recovery and error tolerance.

**Conclusions**

The plant pollinator community in semiarid landscapes and its network of species interaction have the reorganization capacity to face drought events like community recovery, network tolerance, and response diversity. The reorganization of plant pollinator networks to face the drought crisis helps to sustain the pollination service in semi arid landscapes.

**Keywords:** Drought, linkages, species, response, plant pollinator network

**Anwar Muhammad Mushahid****Recreational opportunities and amenities from ecosystem services generated by public parks in megacity Karachi, Pakistan**

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Contributed oral session O22, Managing for ecosystem services

Urban public parks and green spaces could generate a wide spectrum of ecosystem services, among which recreational opportunities and amenities are most appreciated by urbanities. This study explored the recognition of ecosystem services and the pattern and behaviour of urban public parks and green space use in Karachi city. The monetary value of the non-priced benefits was gauged by the contingent valuation method using willingness to pay (WTP) approach. A questionnaire gleaned data by face-to-face interviews of 200 respondents in the 15-60 age cohort dwelling in two different socio-economic gradient (high and low income; defence housing authority and Gulburg town) residential areas selected by a clustered sampling framework. Precautionary measures were adopted to reduce sampling and survey biases. In general, residents in both investigated areas have a dual nature (positive and negative) attitude towards the current performance of public parks and green spaces and the negative impacts from public parks and green spaces are of relatively high importance. Respondents' socioeconomic factors are not significantly associated with their knowledge of ecosystem services generated by public parks and green spaces in Karachi city. Residents in both investigated areas actively used their neighbourhood parks, accompanied mainly by family members. Public parks especially neighbourhood parks were the most popular venues, whereas residential green spaces served as surrogate parks. Visitation is mainly induced not only by accessibility but also different motivation, followed by high green coverage and quality of the ambience; small and low-quality sites near homes were shunned. Urbanities of this megacity harboured pragmatic desires for passive recreation opportunities with subdued expectation for privacy and solitude. They are accustomed to paying entrance fees. Some 97.6% of respondents were willing to pay to use urban green spaces, notably more than other cities.

**Keywords:** Urban public parks and Green space, Ecosystem service, Amenity use, Recreation use, Public goods

**Arias-González Jesús Ernesto**, Cabrera José Luis, González Gándara Carlos

**Ecosystem functioning and biodiversity across reefscales in Alacranes Reef, Campeche Bank, Mexico**

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Contributed oral session O11, Biodiversity and ecosystem functioning 2

The spatial relationships between distinctive habitats and the interaction between spatial elements, notably the biodiversity and the flow of energy or materials among the component habitats were investigated in one of the most complex off-shore coral reefs of the Campeche Bank: Alacranes Reef. We measured biodiversity indices and constructed empirical trophic functioning models for 17 coral reefscales surveyed by the Alacranes Reef Project. The dataset incorporates 47 total fish censuses and videotransects of coral reef benthic communities throughout the reef at equidistant sites. We estimated the potential effect of fisheries in several reefscales. Differences in biodiversity and reefscale functioning associated with habitat complexity and benthic community structure were determined using coral reef fish species, functional diversity groups and trophic functioning. Differences in coral reef benthic composition and fish diversity produce a strong variation in reefscale functioning analyses. Species and functional group richness, composition and abundance of species and ecological diversity of coral reef fishes varied considerably among reefscales. Spurs and grooves, and octocoral reefscales had the highest fish and functional diversity. Ecosystem functioning indicators for each reefscale obtained from trophic analysis showed that the reefscales with greater coral structure, habitat complexity and depth had the highest trophic structure and trophic and ecosystem functioning macrodescriptor values. Reefscales with less coral structure and habitat complexity, had the simplest trophic structure, and the lowest trophic and macrodescriptor values. Results suggest that the biodiversity of coral reef fishes and benthic communities enhances reefscale total production. These results provide ecological values of different reefscales in coral reef ecosystems and the degree of potential loss of ecosystems' services caused by anthropogenic induced perturbations

**Keywords:** Ecosystem functioning, Biodiversity, Coral reefs, Campeche Bank, Mexico

**Arriagada Rodrigo**

**Payments for environmental services and their impact on forest transition in Costa Rica**

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Contributed oral session O20, Economics of biodiversity 2

### **Background**

Some researchers have noted a new dynamic in some tropical forest regions. The idea is that forest cover changes in predictable ways as societies undergo economic development, industrialization and urbanization. Given the potential of forest transitions for slowing soil erosion, improving soil quality, and slowing climate change, can governments speed the transitions up, or, once they have begun, ensure that the transitions continue? Payments for ecosystem services (PES) represent a new, more direct way to promote conservation that can impact both on existing and new forests. The goal of this study is to isolate the causal effect of the Costa Rican Program of Payments for Ecosystem Services (PSA) and its impact on the ongoing Costa Rican forest transition.

### **Methods**

This paper contributes to understanding the causal impact of PSA by analyzing the program on several dimensions of forest cover (forest gain, forest loss and net deforestation), using census data at the tract level combined with remote sensing data on land use and biophysical land characteristics for the entire country. To isolate the causal impact of PSA, matching estimators are applied to identify appropriate controls for census tracts that had land placed under PSA contracts. The control tracts selected through various matching procedures are used to estimate the counterfactual (e.g. forest gain would have occurred had no land in the census tract been enrolled in the program).

### **Results and conclusion**

We found that the program has no statistically significant effect on existing forests, but it does have an effect on the establishment of new forests. All the results indicate that PSA is having an important impact on the forest transition underway in Costa Rica. In light of these results, PSA should be evaluated beyond its impact on tropical deforestation per se. There is almost no empirical analysis of the impact of PES and in particular of PSA on the forest transition underway in Costa Rica.

**Keywords:** Forest transition, Matching, Payments for ecosystem services, Program evaluation, Costa Rica

**Avila-Akerberg Víctor****Forest quality in Mexico City. Assessment towards ecological restoration of ecosystem services**

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Contributed oral session O18, Ecological restoration

**Background**

During the 1990s there have been numerous attempts to define criteria and indicators (C + I) for sustainable forest management on global, regional, national and forest management unit levels. In 1998, the WWF and the IUCN developed an initiative to evaluate the forest quality at the landscape level. The concept proposed by WWF and IUCN (1999) utilizes the forest quality as the principle and subdivides criteria in three overlapping categories: forest authenticity, environmental benefits and social and economic benefits.

This project aims to follow the concept of forest quality, in order to make an assessment of the forests in two of the most important watersheds of Mexico City (around 6,500 ha).

**Materials and methods**

Fieldwork has been conducted, gathering information on forest's composition, structure and function, as well as different spatial parameters describing the topography and physiography of the study area. Interviews and questionnaires with stakeholders about their perceptions about ecosystem services and environmental problems were also done. All this information was synthesized and analyzed using spatial multivariate and multicriteria evaluation methods.

**Results and discussion**

The interviewed people are aware of the importance of the different ecosystem services, but still find it difficult to assess them. The area provides several ecosystem services to the inhabitants of one of the biggest cities of the world: biodiversity conservation (ca. 681 plant species), carbon sequestration (in average 90 tC/ha), water infiltration, as well as recreational opportunities.

**Conclusion**

The generated methodology allowed to visualize the different indicators of forest quality based on fieldwork and expert opinions. This will function as a tool to plan different strategies for management towards conservation and ecological restoration of the forests and their services.

**Keywords:** carbon sequestration, temperate forests, megadiversity, megacities, forest management

**Ballantyne Fiona, Gillson Lindsey, February Edmund****Palaeoecology, fire management and vegetation dynamics in the Cederberg Wilderness Area**

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Contributed oral session O5, Drivers of biodiversity 1

**Background and Goal of Study**

The Cederberg Wilderness Area, in the Cape Floristic Region, South Africa, contains over 2000 plant species, 280 of which are endemic including the endangered Clanwilliam Cedar (*Widdringtonia cedarbergensis*). The area has been subject to different land use for millennia ranging from hunter-gatherers, herders, and farmers to visitors today. The aim of this study was to investigate the impacts of land use and provide a historical baseline for management.

**Materials and Methods**

A sediment core was extracted from a wetland on the shale band of the Cederberg and analysed for fossil pollen and charcoal. Historical records were used to create a timeframe and link changes with land use. A vegetation survey of the site was conducted.

**Results and Discussion**

The largest impacts on vegetation during the last 2300 years are due to grazing management and agriculture during the 1800s to 1940. Fire-sensitive taxa have not declined, apart from *Ericaceae*, suggesting that changes in fire regime have not exceeded a threshold that would affect vegetation composition as determined at the family level. As the pollen record does not show a decline in exploitable species apart from *restios*, the impacts of harvesting appear minimal. Exotic grasses make up 43% of total grass cover on the ploughed area but have not spread. Ploughing also affected the height structure and species composition of the site. The higher grass abundance could increase the probability of fire by providing a fast growing, continuous fuel layer.

**Conclusion**

Ploughing, grazing and invasive grasses, rather than changes in fire regime or resource extraction, are the main causes of vegetation change at De Rif. These impacts are still visible decades after farming ceased. Wilderness management will need to recognise the impacts of people on the sensitive shale step and monitor the recovery of previously farmed areas.

**Keywords:** Palaeoecology, fire management, grass invasion, land use, global change

**Bauch Simone, Pattanayak Subhrendu, Sills Erin****Development, deforestation, and disease: How are deforestation and subsequent land uses related to malaria?**

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Contributed oral session O9, Global environmental change and health

Ecosystem services are critical for the human existence. The relationship between ecosystems and human health is one of the most underappreciated ecosystem services partly because of the lack of clear evidence on the health benefits of ecosystem protection derived from rigorous studies. This paper fills this gap by focusing on 'ecosystem-mediated' health impacts – particularly how deforestation and subsequent land uses (e.g. agriculture, cattle) are linked to malaria incidence. We assess the link between malaria and deforestation in the Brazilian Amazon, against a backdrop of climate change and policy interventions such as protected areas and roads projects, while controlling for socio-economic phenomena such as migration. The data is composed by a multi-year municipality level panel dataset from various agencies within Brazil (IBGE, DATASUS, IPEA and Imazon). Analyses include quantile regressions to identify the drivers of malaria at endemic as well as epidemic levels and panel fixed effects models to evaluate the causal impact of policy levers. Our results show that malaria incidence is positively correlated to deforestation and agriculture while negatively correlated to cattle raising. In the analysis of policy impacts we find that malaria is reduced by protected areas and increased by roads projects (both significant). Our findings show that ecosystem degradation has significant negative impacts on human welfare through health channels and that policy decisions can minimize these impacts.

**Keywords:** Malaria, Deforestation, Land use, Policy, panel models

**Bazile Didier, J-L. Pham, J. Egg, A. Sidibe, E. Martinez, J. Negrete, J-P Muller, F bousquet, P bommel****Preparing a framework for participatory modelling of seed system: development of cross-disciplinary ontology**

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Contributed oral session O3, Agrobiodiversity

**Background**

In the centres of the diversity of crops, farming systems are based on intraspecific genetic diversity. Our objective is to understand how farmers' access to varietal diversity affects the diversity of the genetic resources at various scales, in order to contribute to the definition of management practices adapted to the dynamic in situ preservation of genetic resources. We intend to identify innovative ways of managing varietal diversity based upon the interaction of farmers and commercial and institutional seed systems.

**Methods**

The project includes fieldwork at two contrasting sites: i- the traditional cultivation of sorghum in Mali; ii- the quinoa in Chili using ex situ collections. The methodology is based on the joint construction of agent-based models (ABM) allowing the integration of distinct stakeholder perspectives and simulating the dynamics of biodiversity. This research analyses social structures, the way farmers act, and where and how decisions are made to manage genetic resources.

**Results**

The ABM modelling process will allow the researchers of each discipline to express how they perceive the seed system by developing ontological thematics and then confront these with other models in order to validate, to enhance or to refute each representation. Through this process, diverse actors elaborate a shared vision of the access to the seeds for the peasant to develop a generic model.

**Conclusion**

The first results concerning the ontologies of different social network scenarios confirm that based on more information, which circulates about varieties, the farmer's social network determines access methods to the seeds that impact on the diversity of the genetic resources. Multi-agent simulation is meant to provide a common understanding of farmers' seed management. Our prototype will be used during participative modelling sessions as a framework that will be fleshed out through the interactions with the researchers.

**Keywords:** Agrobiodiversity, Seed System, Modelling, Society, Management

**Belmaker Jonathan, Jetz Walter****Environment and the local-regional richness relationships in terrestrial vertebrates**

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Contributed oral session O5, Drivers of biodiversity 1

The processes that determine community composition may vary enormously across scales. The degree to which predictors of broad-scale ecological patterns scale down to the scale of local communities, where actual interactions among individuals occur, remains unclear. In this study, we contrast the local richness of 330 extensively surveyed terrestrial vertebrate communities worldwide with their respective regional richness at varying scales.

We find that the amount of variation in species richness explained by environmental predictors increased consistently with increased spatial scale. Proportional local richness in relation to regional richness decreased with increased regional richness. Consequently, the discrepancy between local and range-map diversity increased predictably along environmental and latitudinal gradients. However, once gradients in regional diversity were statistically accounted for, little residual variation in local diversity was explained by the local environment. The amount of residual variation increased with the scale used to define the regional species pool. Local net primary productivity and elevation heterogeneity were the best predictors of residual variation between local and range map diversity.

The interaction between the size of the regional species pool and the strength of local species assembly processes will ultimately determine local diversity. Our results suggest that after accounting for regional differences, local richness is relatively insensitive to environmental gradients. This highlights the stochastic nature of local assembly processes. From a conservation perspective, the degree to which regional estimates of richness, e.g. based on range-maps, may provide useful estimates of local richness in e.g. yet unsurveyed reserves varies among taxa and their typical range sizes. However, considerable uncertainty still exists and these estimates will not be considerably improved by using additional environmental data.

**Keywords:** Scale, Local diversity, Regional diversity, terrestrial vertebrates, environmental predictors

**Bidaud Rakotoarivony Cécile****Science's role in the application of ecosystem service in Madagascar**

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Contributed oral session O2, Biodiversity science and policy

Everybody agrees about the importance of science for nature management but the way to share scientific knowledge to inform policy makers is still lacking. A point is: scientific knowledge grows, but poverty and environmental degradation still grow too. How to improve the application of scientific knowledge?

Trying to answer this question, we propose a case study: scientist's role in the application of ecosystem service in Madagascar.

The concept of ecosystem service went from the scientific field into the political debate. It has been created by ecology (ecosystem function) and by economy (function transformed in service). It is now used in the environmental policy in Madagascar, coming after a long history of nature conservation policies: integral natural reserves, integrated conservation and development projects, community management plans.

Does this new vocabulary of ecosystem services bring a concrete change in the field of nature conservation? It depends on what we will do about it.

Different problems arise during the transfer of scientific knowledge to the political application due to differences between those two worlds: temporality, vocabulary, objectives... Those differences may disappear when science is smoothed. In front of a simplified reality, it is possible to inform the political debate and take clear decisions. But the impoverishment of the debate and the lack of controversies may provoke a loss of science's significance, and more practically, weaken practical improvement.

We should be aware not to bring new concepts in old recipes: under a new vocabulary, we brood over the same schema. Not to repeat the same mistakes, scientists should keep the complexity of results, the diversity of discussions and the wealth of controversies.

**Keywords:** science, decision making, ecosystem services, Madagascar, science studies

**Biggs Harry, Ferreira Sam****Can thresholds help the beleaguered Precautionary Principle?**

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Contributed oral session O8, Conservation planning 1

**Background**

IUCN guidelines suggest the Precautionary Principle as sensible only in an adaptive management context. If adaptive management is a response to complex systems, uncertainty and change, what about the equilibrium often (wrongly?) assumed by users of the Principle? Furthermore, supporters and opponents of an argument can evoke the Principle for contrary ends in the same debate, as happened in elephant management. South African National Parks (SANParks) has removed the Principle as an explicit conservation value, retaining it only in the context of integration of development and conservation.

**Materials and methods**

SANParks embraces a complexity of social-ecological systems and has practical experience in applying adaptive management by setting thresholds of potential concern (TPCs). TPCs assume systems are heterogeneous over space and dynamic over time, and aim at either maintaining resilience in relatively undisturbed systems or enabling transformation from a degraded system to another desirable resilient system. Embracing complexity is far-reaching, and early applications of TPCs in adaptive management start by articulating allowable mixes of several defined states in systems, later moving towards a continuum which includes the intervening process transitions. Ultimately it may prove sufficient to allow a specified mix of natural processes to unfold.

**Results, discussion and conclusion**

SANParks' experience suggests that involved parties should work towards enough overlap in their mental models to be able to specify a coherent desired set of future varying conditions for a system. Understanding the drivers and mechanisms that produce this, forms the basis for shared rationality, adaptive testing and ongoing learning. Favouring static versions of desired future conditions in "intact" ecosystems may undermine the variation necessary to sustain them in the longer run. Together with the other factors, threshold use may help resolve such dilemmas.

**Keywords:** adaptive management, learning, heterogeneity, dynamism, shared rationality

**Binet Thomas, Failler Pierre****The valuation of West African marine biodiversity: a case for reconnecting science and policy**

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Contributed oral session O16, Biodiversity governance

In his report "the economics of ecosystems and biodiversity", P. Sukhdev compared the valuation of ecosystem services and biodiversity to a compass which helps decision makers to engage in the conservation of environment and against the loss of biodiversity. Following this road, the authors present the results of an economic valuation of marine ecosystems for a sampling of MPA in four West African countries (Senegal, Cape Verde, Guinea, and Guinea-Bissau). These provide arguments on the importance of the valuation of Total Economic Value in promoting the conservation of marine ecosystems and stopping the loss of biodiversity. In West Africa, biodiversity conservation often faces policy inaction mostly due to a gap between science and policy and this therefore prevents MPA from being correctly enforced: they remain "MPA on paper". This paper therefore shows how the valuation of marine ecosystems can help reconnect science and policy and provide a lever for action toward the conservation of marine biodiversity. In particular, the papers shows how non-use values (which compute both non-merchant services from the ecosystems and the perception and attachment of populations to the marine ecosystems) can provide key testimonies on the need to promote the establishment and strengthening of MPA and provide further instruments to govern under uncertainty and help adapting to change.

**Keywords:** ecosystem valuation, economics of biodiversity, marine protected areas, West Africa, marine ecosystems

**Boissiere Manuel**, Basuki Imam**Realistic or naïve participatory approaches? Local monitoring of biodiversity in fragmented landscapes: a case study from Laos**

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Contributed oral session O2, Biodiversity science and policy

Biodiversity in the tropics is not only important within protected areas, but also at their periphery, where human activities have intensive impacts on the vegetation composition. Monitoring these impacts at the landscape level can be important to development practitioners, decision-makers and communities in order to efficiently engage in natural resource management and land use planning. In the district of Viengkham (Luang Prabang Province, Laos), so far, most monitoring activities have focused on the effects of project interventions. When there was biodiversity monitoring it was often the result of top-down processes: local people were asked to participate, but were excluded from the design of the monitoring activities. Monitoring processes were designed to support conservation issues, occasionally with livelihood components, but were rarely based on local interest and priorities.

In Laos, land use planning (LUP) is an important process for district authorities who perceive it as a means for reducing poverty and the human impact on forested landscapes. We work in the context of LUP, by monitoring its effects on biodiversity, and our results provide examples of participatory monitoring based on local knowledge and the interests of village level actors.

We show that it is possible to develop simple tools to monitor changes in the availability of important resources, which can inform the design of larger scale biodiversity monitoring schemes. The simple design of the monitoring tools means that local and district level actors can use them for the purposes of both livelihoods and the sustainable use of natural resources. Through employing a participatory approach in both the design and implementation of the tools more sustainable monitoring processes can be developed. The successful implementation of these tools, however, cannot be realised in isolation and requires resources and support from higher-level actors.

**Keywords:** biodiversity monitoring, participatory approaches, land use planning, fragmented landscape, Lao PDR

**Borgström Sara****Reconsidering nature conservation in the era of urbanisation**

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Contributed oral session O17, Conservation planning 2

Background and goal of study

With increasing human influence on ecosystems, it is necessary to also include human dominated systems, such as cities, into nature conservation. However, urban landscapes display different characteristics and prerequisites compared to other environments. Therefore the integration of nature conservation frameworks into the urban setting requires reconsideration of why, where and how to protect nature in a purposeful way. By examining the current patterns of nature conservation in landscapes with different degree of urbanisation, this study serves as a starting point for a discussion on the challenges of urban nature conservation.

**Materials and methods**

By using official data on nature protection, current nature conservation patterns were statistically evaluated in 209 municipalities in southern Sweden. The number, size, age, land cover patterns and purpose of appointment of 1869 nature reserves were analysed in relation to the degree of urbanisation.

**Results and discussion**

In cities the nature reserves are fewer, but larger and have a higher diversity of land covers. The land cover compositions showed no differences between urban and rural nature reserves. However, urban nature reserves differ more from their surroundings compared to rural nature reserves. Finally, the urban nature reserves are founded upon more, and more socially oriented purposes. This study showed that nature conservation patterns are related to landscape degree of urbanisation by several variables. The patterns found seem to be an effect of the urban context rather than a conscious strategy of adaptation to the specific urban characteristics.

**Conclusion**

The application of nature conservation frameworks in cities results in specific urban patterns of nature conservation. The main future challenge is to further investigate the causes and consequences of these unintended patterns to enable urban nature conservation strategies that better serve future sustainable cities.

**Keywords:** urban landscapes, nature conservation, nature reserves, landscape ecology, Sweden

**Bozzi Pierluigi**, Granata Silvia, Radin Francesca

**Traditional knowledge and 'equitable efficiency' in African countries: a methodological approach within the context of the Convention of Biological Diversity**

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Contributed oral session O17, Conservation planning 2

One of the major comparative advantages of African countries is the richness in biological and cultural diversity. However, the limited recognition of the enormous value of this 'wide social-natural capital' is leading to continuous loss of species, disempowerment and erosion of resilience for local socio-ecological systems. Local and indigenous communities are the neglected parties of negotiation processes in the international arena. Scant attention has been paid to the complex network of cultural, economic, ecological and institutional relationships at different scales of the value chain of biodiversity products and services. In this context the Convention on Biological Diversity (CBD, 1992) is the most comprehensive policy framework. Art 8(j) of the CBD contains provision to encourage the equitable sharing of the benefits arising from the utilization of knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for biological diversity. The CBD designs a radical institutional innovation providing an operational framework based on dynamic efficiency combined with equitable efficiency – "fair and equitable sharing of the benefits". These principles acknowledge the need to correct the trade and negotiating imbalances generated by the international market failures, and exacerbated by the limited view of allocative efficiency. And overall they legitimize the introduction of the cultural and social environment as endogenous variables in the economic analysis with the aim of changing the inefficient market paradigm by means of institutional interventions. We propose a methodological approach with the aim of providing an institutional economics interpretation of the value chain of biodiversity products and services and associated traditional knowledge. The methodological approach can be tested in two different cases: genetic resources products in Madagascar and tourism services in Ethiopia. This analysis allows a better understanding of why, how and where benefits should be redistributed along the "value network" in order to apply the principle of equitable efficiency.

**Keywords:** traditional knowledge, equitable efficiency, value chain, genetic resources, tourism

**Campbell Bruce**

**When poverty alleviation and biodiversity conservation agendas meet: the Miombo woodlands of Southern Africa**

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Contributed oral session O13, Conservation, conflicts resolution and development

**Background, Goal**

In many cases biodiversity conservation and poverty alleviation objectives are said to be complementary. However the recent literature indicates that trade-offs may indeed be more common than synergies. This paper examines the human dimensions of resource use in the Miombo region of Southern Africa to determine whether poverty alleviation goals and biodiversity conservation are complementary or involve trade-offs. The Miombo woodlands are the most extensive tropical seasonal woodland and dry forest formation in Africa, covering around 2.4 million km<sup>2</sup>.

**Materials, methods**

This work involved an extensive literature review, and the commissioning of five background studies. These studies included detailed household questionnaires exploring the seasonal use of forest resources, in three countries. From these household surveys income profiles were derived.

**Results, discussion**

Plant biodiversity is significant in the Miombo. The Miombo-Mopane woodlands are regarded as one of the five global ecozones needing to be prioritized for biodiversity conservation because of their irreplaceability in terms of species endemism. One hundred million households rely on Miombo woodland, often the poorest of the poor. Household income profiles indicate that Miombo woodlands reduce risk in the face of environmental and economic shocks amongst the most vulnerable households. Incomes from forests/woodlands are some of the highest in the world.

**Conclusions**

Miombo woodlands prevent households from falling deeper into poverty. Given that the persistent poverty in the Miombo region is not going to be solved in the medium term, Miombo woodlands are critical for poverty mitigation. The region is an excellent example of where poverty mitigation and biodiversity conservation goals are complementary. A number of key policy arenas can be utilized to achieve the dual goals, but for biodiversity scientists this means getting deeply involved in poverty alleviation strategies.

**Keywords:** Poverty mitigation, Miombo, rural incomes, policy, Southern Africa

**Cardoso Irene M.**, Duarte Edivania Mg, De Aguiar M. Ivanilda, De Souza Helton N., Fernandes Rafael Ba, Mendonça Eduardo S.

**Agroforestry systems can help restoring the Atlantic Coastal Rainforest Biodiversity**

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Contributed oral session O18, Ecological restoration

**Background**

We developed agroecosystems based on biodiversity and farmers' knowledge to overcome agricultural problems in the Atlantic Coastal Rainforest, Brazil. We transformed full-sun in agroforestry coffee systems, using a participatory approach. Agroforestry systems are important for production, diversification, and nature conservation.

**Materials and Methods**

In 1994, we started 39 experiments on degraded land, in the Zona da Mata, Minas Gerais. From 2003 to 2005, we systematized the agroforestry experiences, using a participatory approach. Moreover, we estimated biomass production of seven tree species used by the farmers. The temperature inside and outside the agroforestry systems was measured monthly during one year. Total soil carbon was measured at three depths in one full sun coffee, one agroforestry coffee and one forest, all neighbours.

**Results and Discussion**

Agroforests diversified production and increased environmental services. More than 80 species of trees, most native, were found in the agroforests. If we transform 50% of the coffee fields in the region (97.000 ha) in agroforests with 50 trees/ha, we will sequester around 115.000 ton C/year. The ideal temperature for arabica coffee ranges from 18 to 23°C. The average temperature in the region is 18°C. When temperature rises with 3°C, according to climate change predictions, coffee production can be at risk in the region. However, the use of agroforests results in a decrease of temperature of 3°C to 5°C. At the same time, soil carbon increased by at least 10% in agroforests compared to full sun coffee.

**Conclusions**

Agroforests can help decreasing the impact of climate change by decreasing the effects of warming through carbon sequestration. The use of biodiversity in agroforests can help mitigate problems associated with climate change in the region and restore the native vegetation of the severely degraded Atlantic Coastal Rainforest. (Acknowledgements: FAPEMIG, CAPES, CNPq)

**Keywords:** family agriculture, agroecology, carbon sequestration, climate change, soil

**Chaves Martha Cecilia**, Reguera Ricardo, Wiersum Freerk, De Koning Jessica

**Certification of indigenous community forest enterprises in the Amazon**

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Contributed oral session O16, Biodiversity governance

The modernization of the law in the Amazon following international concerns on forest depletion has strongly impacted forest users, especially small timber producers. Several initiatives have been undertaken to stimulate and facilitate forest dependent people to further conserve their forests. Timber certification is one of these initiatives that connects globally identified problems related to forest to local forest practices.

The aim of this research is to gain insight in the certification of timber in indigenous communities and comprehend how global design solutions have been adapted to local realities. The research is based on 6 cases related to indigenous forestry enterprises with FSC (Forest Stewardship Council) certification in the Bolivian and Peruvian Amazon. The cases entailed different situations related to timber certification: some were acquiring certification, others were already certified for several years and a few had abolished the initiative. A total of 90 semi-structure interviews were done, 43 with local communities and 47 with external stakeholders (NGOs, government, certification bodies and companies). Secondary data was gathered from documents and archival records. There are three major factors impacting perceptions about certification of community forest enterprises: 1. Economical: e.g. poor marketing and high costs to maintain the initiatives, 2. Technical: e.g. difficulty in achieving FSC standards and, 3. Institutional: e.g. discrepancy between the rhythm of community and the business life-style of wood enterprises. The role of social and economic institutions was found to be the most critical for sustaining the schemes, indicating the complexity that arises when connecting global solutions to local situations in which many different actors play a role. There is a great necessity to include more efficiently the needs, traditions, concerns, views and capacities of small producers in policy and management activities and the timber market

**Keywords:** FSC certification, Community-base conservation, indigenous enterprises, forest management, Amazon

## Chesselet Pascale

### The Global Plants Initiative – a Paris Herbarium perspective

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Contributed oral session O15, Analysing patterns and trends

The Muséum National d'Histoire Naturelle (MNHN), with its rich and historically important botanical collections, has participated in the development of a coordinated digital database of images and information on African plants. Initiated in 2004, the highly successful African Plants Initiative (API) was followed by the Latin American Plants Initiative (LAPI), and in early 2009, the Global Plants Initiative (GPI) was launched. The primary objective of the API was to build a comprehensive online research platform aggregating and linking scattered scholarly resources about African plants. This has been achieved through the collaboration of over 60 partner institutions in Africa, Europe and the United States.

Each of the estimated 60 000 plant species in Africa, Madagascar, and surrounding islands is represented by high-resolution digital images of type specimens and a wide range of related images and data, including photographs, drawings, botanical art, field notes and reference works, all of which comprise over 350 000 objects. These are presented in an interactive Internet site (<http://www.aluka.org/> or <http://www.bores.org>) aimed at research, teaching, and knowledge exchange. Innovative tools developed for the exploitation of these data include search tools, measuring tools for morphological studies, magnification tools for investigation of the high resolution images, as well as the possibility to save subsets of data and the option to share virtual specimens with online collaborators.

Access to African botanical type specimens is no longer an impediment to taxonomic studies of the African Flora and information has now been made available to the countries of origin. Species information provided by API is useful not only to botanists, but to students and scholars in many related academic disciplines. The challenge for the future lies in the exploitation of this mega-dataset in research and educational programmes, inventory work and conservation sciences.

**Keywords:** Botany, databases, nomenclatural types, Africa, Madagascar

## Conti Elena, Keller Barbara

### Does sexual organ placement contribute to reproductive isolation between heterostylous species?

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Contributed oral session O6, Biological diversification

#### Background and goal

A fundamental, yet understudied goal of evolutionary biology consists in explaining the influence of floral trait variation on reproductive isolation. We aimed at clarifying whether the placement of male and female organs in long-styled (pin) and short-styled (thrum) flowers (reciprocal herkogamy) reduces pollen flow between the heterostylous *Primula elatior* and *P. vulgaris*. We asked whether the overlap in the distributions of reciprocally placed sexual organs is higher within than between species, because it is likely that lower reciprocity between species would reduce the efficiency of inter-specific pollen transfer. We also quantified effective inter-morph pollen transfer within and between species.

#### Material and Methods

We measured anther and stigma positions in pins and thrums, quantified the overlap of the resulting frequency histograms, and tested for significant differences with RxC-tests of independence. In a flight cage experiment, we tested whether the pollen delivered by bumblebees from thrums to pins and from pins to thrums was higher within than between species.

#### Results and Discussion

The distributions of reciprocal sexual organs overlapped more than 90% within species, suggesting optimal inter-morph pollen transfer. However, the overlap of reciprocal organs was significantly lower between than within species, with a higher degree of overlap between *P. elatior* anthers and *P. vulgaris* stigmas than vice versa. The overlap between sexual organs placed high in the corolla tube was significantly higher than between organs placed low in the corolla tube, implying that thrum flowers serve as better pollen donors than pin flowers across species boundaries. Overall we found that reciprocal herkogamy is an important pre-mating barrier, contributing a large portion to total reproductive isolation between *P. elatior* and *P. vulgaris*. This study represents the first investigation of the specific effects of heterostyly on species boundaries.

**Keywords:** reproductive isolation, hybridization, heterostyly, reciprocal herkogamy, disassortative pollination

**Costello Mark**, Ward Appeltans, Philippe Bouchet, Geoff Boxshall, Christian Fauchald, Dennis Gordon, Bert Hoeksema, Gary C.B. Poore, Rob van Soest, Sabine Stöhr, Chad Walter

**How authoritative inventories of species may accelerate their rate of discovery**

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Contributed oral session O15, Analysing patterns and trends

**Background and goal**

At the present rate of species discovery, thousands of species may become extinct before they are known. If one-fifth of species have been described to date, it will take 700 years to name all species under a 'business as usual' scenario. However, improved efficiencies in taxonomy can be achieved using online information systems managed by the scientific community. The benefits of this online collaboration are better communication amongst experts around the world, a common working inventory and database of what is the state of knowledge, and enabling clarity about gaps in knowledge that support new proposals for research funding.

**Methods**

Taxonomists are providing an example of such an open-access activity in the World Register of Marine Species (WoRMS, [www.marinespecies.org](http://www.marinespecies.org)) supported by the Flanders Marine Institute and over 160 taxonomic editors. We outline how such technology-supported collaboration may synergise improved taxonomic efficiency; ideally to describe most species by the end of this century. We explore what we know, do not know, but could know, about marine biodiversity.

**Results and conclusions**

Considering that no human activity or business operates without an inventory of its primary resources and metrics of knowledge, and the Linnaean process of naming species has been well established for 250 years, it is a surprise to many that biologists have not inventoried what species they have described. Knowing marine species diversity is a critical step in classifying the evolutionary diversity of life on earth because it includes almost all phyla and classes of life on earth. Estimates of marine species described range from 150,000 to 274,000, and how many exist range from 10 million to 5 million to 0.5 million. We will summarise the limitations of the methods used to estimate marine species richness. The best approach is for taxonomists to inventory species (as distinct from names), as is being achieved through WoRMS.

**Keywords:** taxonomy, databases, ATBI, biodiversity informatics, marine biodiversity

**Cracraft Joel**

**Toward a mechanistic description of biological diversification**

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Contributed oral session O6, Biological diversification

**Background and goal of study**

Many hypotheses have attempted to explain spatiotemporal patterns in diversity within and among clades, geographic gradients in diversity, and large-scale biotic assembly over time. Most proposed drivers of diversification consist of correlations between diversity and some putatively important variable (such as productivity, energy, a trait proposed to be a key innovation, among many others) or to causes such as the availability of empty ecospace. The goal of this paper is to show that when analyzed, these hypothesized causes generally fail to make an explicit, testable link with factors that control rates of speciation (S) and extinction (E).

**Materials and methods**

An analysis of the literature is undertaken and compared to empirical studies of speciation.

**Results and discussion**

It is now widely recognized that allopatric speciation is the predominant mode of speciation in eukaryotic groups that have been studied. This observation allows three key components of the speciation process to be identified that might play a role in modulating S: (a) the geographic isolation (allopatry) of populations, (b) the origin of genetic/phenotypic novelty/variation within populations, and (c) the fixation of that variation to characterize new taxonomic entities.

**Conclusions**

The first-order control of  $S$  is the rate of allopatry, which can be linked to rate changes in Earth history affecting the isolation of populations. This would include tectonically induced landscape alterations or orbital forcing of climate (and others), much of which can operate on temporal scales relevant to the tempo of speciation. There is little compelling evidence for spatial and temporal patterns in rate changes in genetic variation being linked to diversity, such as suggested in species-energy hypotheses, but there is substantial evidence for deterministic controls on the rate of differentiation of isolated populations through natural or sexual selection.

**Keywords:** diversification, speciation rates, extinction rates, Earth history, differentiation

**Cramer Wolfgang**, Rammig Anja, Thonicke Kirsten, Gumpenberger Marlies, Heyder Ursula, Poulter Ben, Katrin Vohland

**Changing climate, land use and fire in Amazonia during the 21st century**

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Contributed oral session O10, Projecting 21st century biodiversity change

Expected losses of forest area in Amazonia result from trajectories of deforestation and climate change, and changing fire regimes play an important role. It has long been noted that seemingly intact tropical forests in the vicinity of deforested areas rapidly degrade. Forest composition changes at forest edges, leading to a drier microclimate and increased tree mortality. These changes favour "escaping fires" at forest edges, but the spatial extent of this degradation has not been part of scenario assessments for future risks to forest integrity and biodiversity. We present results obtained with a process-based model of fire risk, spread and intensity (SPITFIRE), embedded into a dynamic global vegetation model (LPJmL). Following climatic drought and ongoing deforestation, degradation and the associated fires contribute substantially to further loss of forests, thereby releasing additional carbon to the atmosphere. Uncertainty remains concerning the extent of the drought (due to large variation between climate scenarios) as well as concerning the possible buffering against due to higher water use efficiency from higher atmospheric  $\text{CO}_2$ . For several scenarios, however, we find that forest fragments weakened by deforestation and escaped fires become particularly vulnerable to climate change during the second half of the 21st century. Until 2100, we expect carbon fluxes due to escaped fires to contribute up to 20-40 % to the overall loss of biomass (depending on the climate scenario).

**Keywords:** tropical forest, climate, land use, fire, modelling

**Cumming Graeme**, Child Matthew

**Linking biodiversity and ecosystem services: A functional perspective**

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Contributed oral session O22, Managing for ecosystem services

**Background**

Ecology has traditionally focused on the species as the unit for conservation planning and action. Although human societies rely on ecosystem services that are provided by species, species identity is generally less important to human societies than the nature and resilience of ecosystem services. We explored spatial patterns of taxonomic diversity in relation to spatial patterns of functional diversity as a way of bridging the gap between taxonomic and ecosystem service-oriented perspectives.

**Materials and Methods**

We used data from Roberts' Birds of Southern Africa, supplemented with measurements of museum specimens, to develop two different functional classifications for South African birds; one using beak morphology for 150 species, and one using nine a priori functional groups for 950 species. Distribution data were obtained from the South African Bird Atlas. We then contrasted spatial patterns of taxonomic and functional richness nationally and in a set of paired comparisons of quarter-degree cells inside and outside protected areas.

**Results and Discussion**

The spatial distribution of functional groups and of within-group functional richness showed considerable variation in relation to species richness. If the resilience of ecosystem services correlates with functional richness, individual locations may be species rich but function poor, or vice-versa. Paired sites outside protected areas showed a distinct decline in avian species richness, with raptors and scavengers being particularly hard-hit. Our analyses suggest that farming areas in South Africa may be in the early stages of avian trophic collapse (and the loss of ecosystem services, such as waste removal and pathogen suppression, provided by upper trophic levels). More generally, our results show how comparisons of functional and taxonomic patterns offer a potentially useful way of exploring ecosystem resilience to species loss.

**Keywords:** South Africa, avian, conservation, food web, diversity

**Danis Bruno**, Segers Hendrik, De Broyer Claude

**Quantifying Antarctic marine biodiversity and richness using SCAR-MarBIN**

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Contributed oral session O15, Analysing patterns and trends

SCAR-Marine Biodiversity Information Network (SCAR-MarBIN) is a web portal which compiles and manages existing and new information on Antarctic marine biodiversity. SCAR-MarBIN currently consists of over 120 datasets of over one million records. The portal is also home to the Registry of Antarctic Marine Species (RAMS), an authoritative taxonomic list of species occurring in the Antarctic marine environment. This key resource is the companion-project of the Census of Antarctic Marine Life (CAML). The SCAR-MarBIN database provides, for the first time, a way of quantifying not only the diversity and distribution of Antarctic marine life but also a measure of how, when and where it has been studied. Using this unique tool and a range of analytical approaches, we are able to examine the taxonomic, geographic and bathymetric ranges, as well as gaps and limits of the data.

Using this data, we are able to identify critical 'hotspots' of diversity and knowledge as well as important, but virtually un-sampled, regions or taxa. This work also shows the inherent biases within the geographic and bathymetric distribution of sampling locations. Most samples have been taken in shallow water (less than 700m deep), are concentrated around the various research bases or are taken from areas of Open Ocean on regular ship transit routes.

This data forms a useful benchmark for the future, enables the SCAR community to assess the genuine impact of its recent cruises and ongoing work, and highlights key areas, such as the deep sea and the Amundsen Sea, which will require future investigation.

**Keywords:** Antarctic, Biodiversity, Network, Polar, Gap

**De Ruiter Peter**, Moore John, Neutel Anje-Margriet

**Dynamic soil food webs: the interplay between productivity, complexity and stability**

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Contributed oral session O11, Biodiversity and ecosystem functioning 2

Research on the interrelationship between biodiversity and ecosystem functioning has at first strongly focused on species richness on a single trophic level, i.e. vegetation, and the rates of processes like biomass production. The more recent attention to multi-trophic systems made that biodiversity became approached in terms of the number of trophic groups, the lengths of trophic chains and the frequency of interactions, rather than in terms of species richness. It also has drawn the attention to the possible effects on process stability rather than process rates. In my talk I will discuss such relationships between food web structure and ecosystem processing in soil ecosystems.

Soil food webs are extremely species rich communities embracing a myriad of trophic pathways. Moreover, food webs have dynamics in species composition and abundances, population life-history parameters, and individual growth, size and behaviour. Because of the large amounts of materials that are decomposed and processed by the soil organisms, soil food webs are thought to govern major components in the global cycling of materials, energy and nutrients.

In my talk I will especially focus on how soil processes relate to food web structure and stability. Central in the analysis is the idea that food web stability requires a balance between productivity and food web structure. This principle is illustrated by model studies analysing determinants of food chain length, and by observations on real food webs regarding the organisation of energy flows, interaction strengths and food web stability. The interplay between soil processes and soil food web structure is further explored by the analysis of key-components in food web structure, i.e. the lengths and weights of trophic interaction loops in combination with observations on the co-development of productivity and food web structure in two cases of natural primary successions gradients.

**Keywords:** soil, food web, productivity, stability, development

**Dionísio Maria Ana**, Costa Ana Cristina

**Costal area management of small islands in Azores - biological indicators**

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Contributed oral session O21, Monitoring biodiversity

The Azores with its geographical isolation and unique biologic characteristics, including its youth and volcanic origin, present a large percentage of natural habitats and protected species, many of them in coastal areas as the coastal strip represents a large part of the total area of islands. These areas suffer a great anthropogenic pressure and the management of coastal zone plays a strategic role in local and regional development. The biological indicators are one of the monitoring tools to detect change in living systems, namely those

derived by human influence rather than naturally. The goal is to track, evaluate, and communicate the condition of biological systems, and the consequences of human activities on those systems. Fieldwork was carried out to confirm in loco some of the reported species, as it was carried to consider the species distribution for biotope characterization and zonation. Therefore site characterization on shore was performed to report not only the physiographic local features but also all the species and habitats present and their relative abundances. The gathered information was integrated with literature references so that a more complete biodiversity assessment could be made. The official landings in the islands were studied and a new economic/biological index created weight both quantity and value of the landings, of biological resources. Local population and tourists knowledge/use of the coastal area was assessed by public inquiries in these areas. A case study of the role of biodiversity and conservation purposes in the coastal management strategies in four of the smallest islands of the Azorean archipelago: Flores, Corvo, Graciosa and Santa Maria, is herein presented.

**Keywords:** Coastal Area, Management, Azores, Islands, biological indicators

### **Doyen Luc, Thébaud Olivier, Blanchard Fabian, Béné Christophe, Bertignac Michel**

#### **A co-viability model to ecosystem-based fisheries management**

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Contributed oral session O8, Conservation planning 1

Academia and management agencies show a growing interest for ecosystem-based fishery management (EBFM). However, the way to operationalize this approach remains challenging. The present paper illustrates how the concepts of stochastic co-viability, which accounts for dynamic complexities, uncertainties, risk and sustainability constraints, can be useful for the implementation of EBFM. In the present case, this concept is used to identify fishing strategies that satisfy both ecological conservation and economic sustainability in a multi-species, multi-fleet context. Economic Viability Analysis (EVA) and the broader Co-Viability Analysis (CVA) are proposed to expand the usual Population Viability Analysis (PVA) and the precautionary approach. An illustration is proposed, using data of the fisheries of Bay of Biscay and Celtic Sea exploiting the European stocks of nephrops and hake. Stochastic simulations show how CVA can guarantee both ecological (stock) and economic (income) sustainability. A window of fishing intensities that ensure such co-viability is identified, suggesting a 28% reduction in the fishing effort of both fisheries with respect to the 2006 baseline level.

**Keywords:** Ecosystem based fisheries management, co-viability, modelling, marine biodiversity, Bay of Biscay

### **Driver Mandy, Biggs Harry, Roux Dirk**

#### **Bridging the divide between science, policy and practice: Lessons from the South African experience**

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Contributed oral session O2, Biodiversity science and policy

Translating good science into good policy, and then into good practice, is not an easy task. Scientists often say that managers ignore their research and advice, with managers countering that scientists don't provide helpful solutions for real-world management challenges.

South Africa has considerable experience in using our excellent biodiversity science to support policy implementation and better biodiversity management. The country is unusual in having a Biodiversity Act (2004), which established the South African National Biodiversity Institute and gave us a range of new tools for biodiversity management and mainstreaming.

This presentation will explore the challenges of translating biodiversity science into policy and practice, drawing on practical experiences from developing policy instruments (such as the National Protected Area Expansion Strategy) and tools for mainstreaming biodiversity in land-use planning and decision-making (such as listing of threatened ecosystems).

A key lesson is that translating science into policy and practice is a messy and inexact business, not for the fainthearted. Purism is not useful, and "best available" science is often better characterised as "good enough" science. The problem relates partly to the different worlds that scientists, policymakers and managers inhabit, with attendant social and cultural divisions between them. Building real working relationships across these cultural and social divides is a critical success factor. Scientists cannot afford to see themselves as detached experts who deliver knowledge to managers and policymakers, but must assume the role of collaborative learners and facilitators of knowledge generation in a science-policy-practice partnership. This requires skills and competences that are not traditionally associated with scientific training and career advancement. It can be useful to involve people with specialist expertise in working at the interface between these three worlds.

**Keywords:** science-policy interface, science-management divide, knowledge interface, best available science, evidence-based policymaking

**Drucker Debora P.**, De By Rolf A., Joly Carlos A.

**Human understanding of biodiversity: representation of inventories with database systems to support conservation strategies**

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Contributed oral session O21, Monitoring biodiversity

Reducing uncertainties related to biodiversity estimatives is crucial to improve information to support decision making about conservation strategies and sustainable use. Inventory data is an important source of the base data upon which biodiversity research is founded, and the development of reliable database systems combined with consistent formal representations of human understanding is a challenge to advance on biodiversity science. This study aims to contribute to better represent data collected in biodiversity inventories: ecological, environmental, and specimen. Twenty different biodiversity assessments at the Brazilian Amazon and Atlantic Forest were documented at a database system designed to accommodate inventory data. A few characteristics of our approach to the database system make biodiversity inventories documentation warranted: our repository is spatially enabled and generic, designed in such a way that it accommodates data of any kind of inventory, even future ones for which the design still has to be established; and accommodates easily the support of external users, such as scientists that conduct inventories. Formal descriptions of data were based on the investigation of the history of different disciplines related to biodiversity surveys, ensuring concepts representations were consistent and allowing ambiguous terminology detection. We present terms which revealed inconsistencies and suggest means to benefit from them, enriching descriptions of data and allowing inferring relationships between concepts. The representation of human knowledge on biodiversity through a unified mechanism improved effective querying across databases to find relevant data and allowed determining similarities between datasets. Our approach and results showed that consistent representation of biodiversity concepts associated with a database system reduced ambiguity and can contribute to improve the human understanding of the consequences of present choices.

**Keywords:** Biodiversity Databases, Inventory, Observation, Tropical Forest, Information

**Ferrier Simon**, Faith Dan, Williams Kristen, Manion Glenn, Stein Janet, Rosauer Dan

**Adding value to remotely-derived indicators of biodiversity change through modelling of spatial patterns in biological composition**

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Contributed oral session O19, Biodiversity indicators

Large-scaled assessments of change in the state of terrestrial biodiversity, including those relating to the Convention on Biological Diversity's 2010 target, often rely heavily on indicators derived from remote sensing. These are usually generated by intersecting remotely-sensed changes in land use or cover with mapped classes – e.g. ecoregions or ecosystem types – serving as broad surrogates for background (natural) patterns in the distribution of biodiversity. Any such class typically exhibits internal variation in biological composition, and varying levels of compositional distinctiveness relative to other classes, yet these components of diversity are rarely considered in the derivation of change indicators. Recent advances in modelling spatial patterns in biodiversity composition, by linking biological specimen and observation data (such as those accessible via GBIF, the Global Biodiversity Information Facility) to finer-scaled environmental surfaces, offer a cost-effective means of refining remotely-derived indicators of biodiversity change.

We here explore potential applications of this approach using a current case study for the Australian continent, which has links to both the GBIF for 2010 campaign, and the GEO (Group on Earth Observations) Biodiversity Observation Network early-products initiative. This study makes use of recent modelling of compositional patterns across the continent as a function of fine-scaled environmental and biogeographical correlates, calibrated with best-available data for various biological groups. These modelled patterns are employed as a "lens" through which past changes in land use are translated into expected changes in the conservation status of biodiversity. The approach can also be integrated with modelling of future scenarios of land use, and conservation action, to assess potential consequences for biodiversity, and for ongoing progress in relation to conservation objectives such as the 2010 target.

**Keywords:** biodiversity, change, indicators, modelling, composition

**Foden Wendy**, Jean-Christophe Vié, Ariadne Angulo, Stuart Butchart, Lyndon DeVantier, Holly Dublin, Alexander Gutsche, Vineet Katariya, Susannah O'Hanlon, Tony Rebelo, Simon Stuart, Emre Turak and Georgina Mace

**Assessing species vulnerability to climate change**

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Contributed oral session O14, Biodiversity and climate change

**Background and goal of study**

There is growing evidence that climate change will become one of the major drivers of species extinctions in the 21st century. But it is also clear that some species will be more vulnerable to climate change effects than others. Based on assessments of individual species' biological susceptibilities, their predicted climate change exposure, as well as their anticipated adaptability to climatic change, IUCN is developing a tool to identify the species most vulnerable to climate change impacts.

**Methods**

Piloting the approach for global birds, amphibians and corals, as well as South African *Proteaceae*, we assess individual species' climate change susceptibility and adaptability according to a range of ecological, behavioural, physiological and genetic traits believed to be associated with species declines due to climate change. Species-specific climate change exposure assessments are derived from General Circulation Model projections.

**Results and discussion**

We highlight species predicted to be at greatest risk from climate change and identify the regions of their greatest concentrations. We also investigate the relationship between pilot species' predicted climate change vulnerability and existing Red List status. IUCN plans to use the climate change vulnerability assessment tool to complement IUCN Red List assessments of extinction risk and serve as a 'warning flag' highlighting the need for intensive monitoring and potentially for conservation action for the affected species.

**Keywords:** climate change, species, extinction risk, life history traits, IUCN Red List

**Fortes Miguel**

**New approach to biodiversity conservation in Southeast Asia: Integration of social-ecological systems in coral reefs, seagrass beds and mangroves**

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Contributed oral session O4, Managing biodiversity with a social-ecological system focus

The coasts of Southeast Asia are characterized by complex spatial patterns of endemism of species and diversity of habitats. However, these patterns are coupled to an equally diverse and wide range of uses of these resources by a rapidly growing coastal human population. For effective conservation, these conditions require multi-, rather than single-pronged approaches to promote species and habitat resilience and sustainability. It is increasingly recognized that coral reefs, seagrass beds and mangrove forests in the region are linked by high-order interactions in terms of nutrients, plant dispersal, animal migration, physical processes, and human impacts. These linkages imply that if you disturb one ecosystem, you disturb the other; if you conserve one, you conserve the other.

Coral reef, seagrass and mangrove conservation strategies in Southeast Asia such as marine protected areas have met limited success due largely to inadequate attention to the social context of conserving these marine resource systems. While some ecological concerns are imperative, socioeconomic factors are critical for the success of such common-property institutions as MPAs because they can influence decisions on how users adopt restraints on resource use. In contrast, where these factors are inadequately and poorly reflected by MPA strategies and action plans, low compliance rates result and outcomes such as free riding and overexploitation are likely.

This social-ecological systems approach is an emerging trend in coastal conservation in Southeast Asia. It arises, in part, from an increasing understanding of the profound human influence on the goods and services coastal ecosystems provide and upon which the people themselves depend for survival. It underlines the emergence of a complex systems approach for sustaining coral reef, seagrass and mangrove ecosystems, linking habitat resilience to economics, local institutional structures, and society.

**Keywords:** Social-ecological systems, Southeast Asia, habitat linkages, seagrass, mangroves

**Freyhof Jörg**, Kottelat Maurice, Smith Kevin, Darwall William

**First ever complete assessment of European freshwater fishes reveals unexpected high threat levels**

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Contributed oral session O15, Analysing patterns and trends

The first complete European IUCN Red List could assess 522 native freshwater fishes, about twice as many than hitherto recognized. The highest species richness is found in the main channel of the Black and Caspian Sea tributaries. The highest concentrations of species with small distribution ranges are situated in south-eastern Europe and in the lakes of northern Europe and the Alpine range.

198 (38%) of Europe's native freshwater fish species are globally threatened, facing a much higher level of threat than Europe's birds (4.9% of 488), mammals (13.5% of 223) or amphibians (23.8% of 84). 61 European fish species (12%) are listed as critically endangered. Two percent are considered extinct (11 species). Out of 522 species, 223 (43%) are restricted to Southern Europe, 53% of which are listed as threatened (120 species) in contrast to 78 (26%) in other parts of Europe. Out of 62 species listed as critically endangered even 34 (55%) are restricted to Southern Europe.

Only few species are threatened by direct human impacts. Overexploitation has led to massive population declines in sturgeons (*Acipenseridae*) with eight of the nine species being provisionally classified as critically endangered. Also the European eel is now listed as a critically endangered species due to a population decline of more than 90%. Atlantic salmon provisionally classified as vulnerable is being strongly affected by water pollution, damming, and hybridization with farm salmon, alien parasites and overfishing.

The main threats behind the high level of extinction risk of threatened European freshwater fishes stem from the massive development and population growth in Europe. Water extraction, particularly in dry Mediterranean areas, has led to rivers drying up in summer threatening 49% of the species. Water pollution (threatening 55% of the species) and alien invasive species (37%) also led to population declines and extinctions. Large dams also had major impacts (31%).

**Keywords:** aquatic biodiversity, extinction risk, Mediterranean, IUCN, Europe

**Fritz-Vietta Nadine**, Stoll-Kleemann Susanne

**Community-based natural resource management: The relevance of leadership and positive incentives for members of local associations**

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Contributed oral session O16, Biodiversity governance

**Background and goal of the study**

In Madagascar community-based natural resource management (CBNRM) is part of the national protected area policy. It seeks to decentralize management duties to local associations in order to foster a sense of responsibility and to let people benefit from biodiversity in their proximity. However, the involvement of local associations into decision-making requires a well-organized collaboration between different actors. With this study we want to highlight the diverse roles of protected area staff and local association members in CBNRM. This is explored with reference to a case study in two Malagasy biosphere reserves.

**Materials and methods**

In a qualitative social research data was collected through semi-structured interviews with conservation and development experts and the biosphere management staff. Participatory rural appraisal was applied with representatives of local associations.

**Results and discussion**

For a transfer of management rights, Malagasy policies instruct local communities to create associations. The protected area management staff encourages their establishment, provides support in project initiation and information for sustainable resource use. Although at the beginning people are usually willing to participate, when benefits fail to appear, they leave the association and return to traditional practices. Considering the claim to provide positive incentives, a functioning coalition of true leaders and protected area management staff seems essential. Team building with qualified role allocation in the association and an explicit direction of activities is required.

**Conclusion**

Based on these findings we derive types of essential characteristics for a clear leadership within the association, define the role of management staff as mediator and how mutual learning between the different collaborators can be facilitated to promote interest and engagement of the people. This is also applicable in other cases of CBNRM.

**Keywords:** community-based natural resource management, local associations, Madagascar, biosphere reserves, leadership

**Froeschke Götz**, Harf Rainer, Matthee Sonja, Sommer Simone

**Effects of precipitation on parasite burden along a natural climatic gradient in southern Africa – implications for possible shifts in infestation patterns due to global changes**

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Contributed oral session O9, Global environmental change and health

**Background and Goal of Study**

As a consequence of environmental change it is expected that shifts in temperature and precipitation patterns will influence parasite communities and their hosts with unpredictable impact. Parasites play a vital role in ecosystems but there is only limited quantitative data which describe the effects of environmental parameters under natural conditions. We predict that the prevalence of helminth parasites in small mammals will be dependent on climatic variables such as rainfall, relative humidity and temperature – leading to higher burdens in a wetter climate.

**Materials and Methods**

We used the striped mouse, *Rhabdomys pumilio*, as a model to describe the effects of meteorological parameters on the parasite burden along a precipitation gradient from the Cape of South Africa to northern Namibia. We trapped 470 mice over a geographical distance of ca. 1400 km. Faecal egg counts of 439 sampled individuals and dissections of 161 gastro-intestinal tracts have been analysed.

**Results and Discussion**

Our study revealed a significant positive correlation between mean annual precipitation and nematode infestation rates of animals and a negative correlation with temperature. In addition, we detected associations between precipitation and different qualitative measurements of parasite burden (mean nematode species richness, mean number of nematode worms and infection intensity per individual host). Ongoing analyses try to fill in the lack of intrinsic investigations considering the effect of immune gene variations (MHC) within the hosts.

**Conclusions**

This is the first empirical study conducted along a natural precipitation gradient that showed significant correlations between precipitation and parasite burden over a large geographic range in small mammals in Southern Africa. The results might be incorporated in the development of models, which can predict possible shifts in infestation pattern due to global changes.

**Keywords:** climatic gradient, parasite load, nematodes, small mammal, Southern Africa

**Gabriel Doreen**, Kunin William E., Sait Steven M, Stagl Sigrid, Benton Tim

**The spatial aggregation of organic farming in England and its underlying environmental correlates**

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Contributed oral session O3, Agrobiodiversity

**Background and Goal of the Study**

Given the current debate on the global food crisis, conservation in Europe is expected to shift from maximising biodiversity at the expense of yield to conserving biodiversity under food production constraints. Organic farming is potentially of great importance for environmentally sustainable farming. Understanding the distribution of organic farms and the environmental, social and cultural correlates is necessary to predict the way in which this may change over time.

**Material and Methods**

We collated data from 30 variables describing the topography, climate, soils, farm size/type, human population characteristics and farm business in the English agricultural landscape. Factor analysis reduced these variables to six orthogonal axes, which describe the agri-environmental landscape.

**Results and Discussion**

An analysis of the distribution of organic farms showed that they are spatially aggregated at the regional and neighbourhood scales. Their presence and concentration in a 10x10 km grid square can be predicted from statistical models including the six landscape axes and a term to account for spatial aggregation. Our results show that a combination of environmental variables associated with a lower agricultural

potential predisposes farmers to convert to organic farming, which further promotes conversion of farmers in the neighbourhood. Organic farming as a “wildlife friendly” method is more likely to occur in agriculturally less favoured areas, where economic incentives for conversion to organic farming do not need to be high and the loss of production due to conversion will be comparatively small.

### Conclusion

This suggests that an efficient conservation strategy, which takes the global demand for food into account, would be to promote organic farming as an agri-environment scheme in landscapes that are already rich in organic farms at the expense of those existing high-production landscapes that are not.

**Keywords:** agri-environment scheme, biodiversity, conservation, land sparing, policy implications

**García-Barríos Luis**, Waterman Andrew, Brunel Manse Claudia, Cruz Morales Juana,

García Barríos Raul

### **A generic board-game addressing conflict and cooperation between stakeholders involved in managing land, forest and water in the buffer zone of a megadiverse Biosphere Reserve**

El Colegio de la Frontera Sur, Agroecology, Mexico

Contributed oral session O4, Managing biodiversity with a social-ecological system focus

Participatory scoping and consensus building is crucial in buffer zones surrounding megadiverse Biosphere Reserves in tropical countries, as a number of social actors converge with different and sometimes very conflicting views and interests regarding rural livelihoods and natural resource management. As a first step in building a role playing game and companion model for the Sepultura Reserve in Chiapas, Mexico, we have developed – with active stakeholder collaboration- a generic land-use board-game. Its purpose is to help stakeholders reduce social conflict and enhance cooperation in watershed management, but also to motivate stakeholders to tailor it or modify it substantially to meet their more specific views and interests regarding agrodiverse landscape management. Each of four players colonizes a quadrant of a watershed with different types of land-use-tokens (simplified vs. agrodiverse) having different values. The game has 5 levels. In the competitive modes of the game, whoever makes N points first, wins. In the cooperative modes, the game is solved like a board puzzle and unless everybody makes N points, nobody wins. Government Agencies subsidizing different land uses can either cooperate or defect while promoting their interest, with effects on players’ decisions and on the dynamics of the game. Colonization has: (1) management restrictions; (2) social restrictions; (3) local and global deforestation consequences on water supply and livelihoods; (4) cooperation dilemmas and tradeoffs between players, and coordination dilemmas between government agencies in the cooperative mode of the game. Cooperative modes following competitive modes enhance players’ awareness of the virtues of collective action for agrodiverse landscape construction, and allow players to perceive at least four ways of being equitable and cooperative, and the synergies and tradeoffs between these options. Results from multi-stakeholder workshops will be presented and discussed.

**Keywords:** decision making, companion modelling, role-playing games, agrobiodiversity, land management

**Gaugris Jerome**, Vasicek Caroline

### **Measuring the effects of rural human population dynamics on forest dynamics – 20 years of abuse and a way forward: a case study in Maputaland, South Africa**

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Contributed oral session O4, Managing biodiversity with a social-ecological system focus

### **Background and Goal of Study**

This study details population structure changes of 29 tree species of Hlathikulu Forest Reserve in South Africa’s Maputaland over a 20-year period during which household numbers doubled around the reserve. A longitudinal study design allowed the evaluation of the effect harvesting had on tree species’ population distribution and forest dynamics. Moreover, we evaluated whether sustainable use principles implemented in 1987 had been successful.

### **Materials and Methods**

Size class distributions analyses with regressions were conducted to analyse tree survey data. Interviews and inventories were conducted to document wood use in households.

**Results and Discussion**

While 37.5% of tree species populations' trends were significantly less healthy in 2007 than in 1987, the regeneration potential (seedling and sapling pool) of 80.4% of species was significantly lower. The population curve patterns from tree species documented show that on average 45.1% of the regeneration potential was lost and >95% in some instances. All changes were clearly linked to either direct harvesting or forest dynamics changes caused by harvesting; thereby changing conditions in the forest to the extent that recruitment may have become impossible for some species. Sustainable use options were impossible for any of the species investigated. Interviews revealed that measures taken in 1987 had been misunderstood, which led to "legally uncontrolled harvesting". Overall forest dynamics were seriously affected and time scales involved are such that effects of harvesting from the past 20 years only begin to appear in 2007, thereby reducing ecosystem services possibilities.

**Conclusion**

Sustainable harvesting options are now impossible and alternative ways of providing wood products need defining, or changes in local utilisation patterns need to be implemented. Ingenious locally developed solutions akin to agro-forestry and new building styles are worth considering.

**Keywords:** Abundance, dynamics, forest, population, utilisation

Gillespie Thomas, **Rwego Innocent****Environmental Change and Pathogen Transmission Between Humans and Wild Apes**

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Contributed oral session O9, Global environmental change and health

Infectious diseases pose a significant and growing threat to the health, well-being and long term viability of wild primate populations. Anthropogenic environmental change can result in a suite of alterations in host ecology, habitat structure, and human-wildlife overlap that can dramatically alter infectious disease risks for resident endangered wildlife. Our investigations of chimpanzees (*Pan troglodytes*) in Tanzania, chimpanzees and lowland gorillas (*Gorilla gorilla*) in Republic of Congo, and chimpanzees and mountain gorillas (*Gorilla beringei*) in Uganda demonstrate that forest fragmentation, selective logging, and agricultural intensification can introduce novel pathogens and increase the transmission of zoonotic pathogens and associated antibiotic resistance in endangered ape populations. Results of these studies point to strategies to limit environmental transmission of such pathogens to benefit human and ape health.

**Keywords:** EcoHealth, Endangered Species, Chimpanzee, Gorilla, Congo

**Godbold Jasmin**, Bulling Mark, Solan Martin**Effects of biodiversity and habitat structure on bioturbation intensity and nutrient generation**

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Contributed oral session O11, Biodiversity and ecosystem functioning 2

**Background**

Habitat fragmentation and homogenisation are expected to substantially affect global biodiversity over the next century, but their effects on ecosystem processes are still unclear. Manipulative experiments explicitly testing the relationship between biodiversity and ecosystem processes have largely been carried out in isolated, homogenous environments that do not incorporate structural heterogeneity and therefore do not allow for the development of natural community dynamics. Here we experimentally investigated the effects of biodiversity, faunal movement and habitat structure on bioturbation and nutrient generation in marine benthic communities.

**Materials and methods**

Using three marine invertebrate species (*Hediste diversicolor*, *Hydrobia ulvae*, *Corophium volutator*), various configurations of a multi-patch model system were established to investigate the effects of biodiversity, resource heterogeneity and patch connectivity on faunal movement, bioturbation intensity and nutrient concentration at both the patch and multi-patch scale.

**Results and discussion**

The results show that allowing fauna to move and preferentially select patches alters the composition and density distribution of species assemblages. This can have negative effects on ecosystem processes (bioturbation) at the patch scale, but overall positive effects on ecosystem functioning (nutrient concentration) at the multi-patch scale because of species-specific differences in the way fauna interact with each other and their environment.

**Conclusion**

These findings indicate that local community dynamics in response to changing habitat structure can have profound effect on the magnitude and slope of the relationship between biodiversity and ecosystem process and/or function. Thus failing to incorporate such natural processes will lead to an incomplete understanding of the ecosystem consequences of biodiversity loss.

**Keywords:** biodiversity, ecosystem function, habitat structure, resource heterogeneity, community dynamics

**Gómez-Baggethun Erik**, Martín-López Berta, García-Llorente Marina

**Hidden values in ecosystems services: a comparative analysis of preference outcomes obtained through monetary and non-monetary valuation methods**

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Contributed oral session O20, Economics of biodiversity 2

**Background and goal of study**

Ecosystem services valuation can be performed through alternative approaches including individual vs. group-based valuation and monetary vs. non-monetary valuation. Whereas it is widely accepted that individual and group deliberation-based valuation may lead to different outcomes, it is generally assumed that valuation methods based on individual rationality should lead to equal preference outcomes. Neoclassical economics theory assumes that utility, measured as individuals' consumer surplus for a given good or service, provides an objective quantitative measure to social preferences. However, this axiom has been contested on the grounds that i) utility can not be properly measured, and ii) monetization does not capture specific ecosystem values. The present paper aims to shed light on this controversy using empirical data from ecosystem services valuation.

**Materials and methods**

The research is based on a case study in the Doñana protected area (SW Spain). A set of eight ecosystem services is valued, first through monetary methods - using market prices, revealed and stated preferences methods - and then through a non-monetary valuation method based on preference ranking. Data were analyzed with statistical methods and the outcomes were compared.

**Results and discussion**

Results show a gap between the outcomes of monetary and non-monetary valuation methods witnessed by diverging hierarchies of preferences to ecosystems services suggesting the existence of value types and/or components that are not properly captured through monetization (e.g. deontological values).

**Conclusion**

We conclude that i) further research is needed to assess which are the specific components and value types of ecosystems that may not be captured through monetization and ii), there is a need to develop frameworks that allow for the integration of inputs from monetary and non-monetary valuation methods in decision-making processes while avoiding double counting.

**Keywords:** ecosystem services, non-monetary valuation, monetary valuation, deontological values, Doñana protected areas

**Gonzalez Carla**, Aargaard Nielsen Kurt, Branquinho Cristina, Ferreira Santos Rui

**Transdisciplinary analysis of Nature-Society relationships for Mediterranean Streams Management**

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Contributed oral session O4, Managing biodiversity with a social-ecological system focus

The implementation of conservation efforts in an area is a driver requiring adaptation from remaining land uses, often showing up conflicts amongst users. These conflicts, widely addressed by NGOs, scientific and state institutions, may develop to unsuccessful implementation of conservation plans. We hypothesize that diminishing the disciplinary-sector and knowledge-type boundaries in applied social-ecological analyses can help facing these conflicts in management. We propose this could be achieved by adopting transdisciplinarity and collaborative strategies in such analyses. Our objective is to demonstrate how this approach can aid the conservation of biodiversity. A case study was developed in the 2000 Natura Site of Monfurado, an area with conflicting land uses between conservation and farming: i) it has several aquatic habitats and species of priority conservation listed in the EU Habitat Directive and ii) is a mainly privately owned area of farming and cattle activities with resulting diversion of water, organic pollution and eutrophication. Around 30 sampling sites in Monfurado streams were the ground for an experimental design based on complementarities between methodologies from i) the social sciences:

value survey of ecosystem services and analysis of discourse; and from ii) ecology: biomonitoring and integrity biotic indexes. Results characterized surface water systems from the ecological and social points of view and as well the relationship between both dimensions. We concluded that a well established riparian vegetation cover of streams is a key structural element in the Nature-Society relationship in streams of Monfurado, revealing common interests between landholders and conservationists. The central role this structure might have in the dialogue between the cited conflicting land uses, with regard to streams conservation, is discussed with a further perspective of change in long-term social relationships, and priority targets for management are identified.

**Keywords:** Mediterranean Stream Management, Social-Ecological Systems, Transdisciplinary Integration, Local Knowledge, Ecological Indicators

### **Grant-Biggs Rina, Kruger Judith, Vickers Karen**

#### **Developing an index of heterogeneity as an indicator of biodiversity for the Kruger National Park**

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Contributed oral session O19, Biodiversity indicators

#### **Background and goal**

Biodiversity is a central theme in conservation, and credible endpoints indicating an unacceptable loss are essential when monitoring to elicit adaptive management responses. South African National Parks uses a system of thresholds of potential concern (TPCs). Because exact thresholds are usually not exactly known, TPCs are hypotheses based on the best available knowledge, and require testing and adaptation as we manage and learn. This paper describes an attempt to incorporate the most important aspects of structural and community diversity into one index that links species and structural diversity with the underlying template. A loss of dissimilarity is used as the indicator of homogenisation and the associated loss of resilience and ecosystem function.

#### **Materials and methods**

Dissimilarity is measured using a Bray-Curtis pairwise measure in the major habitats within an abiotic unit, defined by rainfall and geology. Dissimilarity values for each biodiversity component are expressed as a percentage of the pairs that are very similar or dissimilar. In each unit the components are tested against the minimum number of homogenous pairs that are acceptable for that unit (defined by best available data), and either passes or fails. The outcome of the component test is tabulated and a TPC is exceeded when the total number of failed component scores drops below a specified point or, due to its importance for biodiversity, if the structure component fails.

#### **Results and discussion**

At least 5 sites are required for each unit with at least two habitats in each. Birds are suitable and ants and dung beetles of the insects can readily be used in the index. Preliminary results indicate that failure of the woody structure component in several landscapes associated with a loss of specialised bird guilds.

#### **Conclusion**

This index offers hope for the evaluation of biodiversity survey results in a complex system and is still being further developed and evaluated.

**Keywords:** homogenisation, thresholds, dissimilarity, structure, monitoring

### **Griffiths Charles**

#### **Marine biodiversity in South Africa – evaluating the state of knowledge**

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Contributed oral session O15, Analysing patterns and trends

#### **Background and goals of study**

This presentation aims to document the history and current status of marine biodiversity research in South African waters.

#### **Materials and Methods**

We present historical data on the dates, locations and depth distributions of benthic samples taken in the region and estimate the validity of current biodiversity estimates by comparing relative proportions of various taxa with similar lists for Europe. Biogeographic patterns of biodiversity are also examined for 13 major taxa.

### Results and Discussion

There is an extremely uneven geographic spread of samples and a very poor coverage of waters deeper than 1000 m, which comprises some 70% of the EEZ. A total of some 12 000 marine species have been recorded from South Africa to date, of which 32% are endemic. Comparative analyses suggest that only some 60% of the macrofaunal species actually present have been described. Taxa with smaller body sizes and from deeper waters are particularly under-reported. The state of knowledge is also influenced by local 'taxonomic impediments' - those groups lacking any local taxonomic expertise often being severely under-reported. Analyses of distributional data show that several taxa, including fish, decapod Crustacea and Gastropoda, increase in diversity towards the east, whereas Amphipoda, Isopoda and Polychaeta are most speciose in the South-West. When all taxa are summed, the Atlantic coast emerges much less species rich than the Indian Ocean coast. Rates of endemism vary greatly between taxa and peak in the South and South West. Narrow range restricted endemics peak strongly at the borders between major biogeographic provinces, suggesting that these 'ecotonal' areas are particularly important for conservation.

### Conclusions

Enormous opportunities for discovery exist in this region and we conclude by illustrating some remarkable recent taxonomic finds from the area.

**Keywords:** marine, biodiversity, South Africa, estimation, biogeography

**Guégan Jean-François**, Benjamin Roche, Eric Benbow, Richard Merritt, Ryan Kimbirauskas, Mollie McIntosh, Heather Williamson, Pamela L. C. Small

### Ecological interactions in local communities, disease transmission and health: *Mycobacterium ulcerans* transmission in Africa as a case-study

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Contributed oral session 09, Global environmental change and health

*Mycobacterium ulcerans* causes Buruli ulcer an emerging, debilitating disease in many tropical countries, therefore, it is crucial to understand how it is transmitted from natural and/or man-made ecosystems to humans. Moreover, virtually nothing is known about its mode of transmission within aquatic communities. Using a mathematical model supported by quantitative data from 27 different localities in West Africa, we have developed an optimal "disease web" model which represents how this disease agent might be transmitted within aquatic host communities. The study of "disease web" transmission allows us to identify communities which may ensure a high stability of *M. ulcerans* transmission. We show that the high complexity of these "disease webs", represented roughly by the number of links involved within each host species community, is likely to ensure a permanent transmission of the infection within the environment and potentially to humans. We observe the absence of a relationship between the keystone characteristic of some taxa, i.e. taxa without which *M. ulcerans* transmission might be compromised like aquatic bugs which have been suspected to transmit the pathogen, and their occurrence. Nevertheless, we identify the Oligochaeta taxon as a group of organisms highly involved in the transmission of *M. ulcerans*. Oligochaeta could be considered a keystone taxon since its removal from our mathematical model decreases dramatically the predicted prevalence of the mycobacteria within local aquatic communities. In addition, this taxon could be used as a biological indicator of *M. ulcerans* presence within pristine and/or disturbed aquatic communities. Besides its applied aspect for the understanding of *M. ulcerans* ecology, this study underlines the efficiency of parasite transmission through complex ecological webs, and advocates for a better integrative understanding of the transmission pathways of environmentally-persistent disease agents in public health concerns.

**Keywords:** community ecology, disease transmission, ecological interactions, trophic webs, public health

**Guerbois Chloé**, Doyen Luc, Fritz Hervé

### Elephants in the fields: A bio-economic model for meeting conservation and development objectives through source-sink management from protected area.

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Contributed oral session 04, Managing biodiversity with a social-ecological system focus

### Background and goal of study

Protected areas are a major instrument to protect wildlife especially in Africa. To truly apprehend the wildlife management in those areas, the integration of human activities effects into the conservation objectives is necessary. Thus, understanding how the protected areas may contribute to the sustainable development of the human activities in the periphery through, for example, a Community Based Natural Resource Management program is also needed. This study explores the effects of a source-sink system between the Hwange National Park (Zimbabwe) and its peripheries, for the long term management of the elephant population (*Loxodonta africana*).

**Methods**

Using recent data (1986-2001) including key factors controlling the elephant distribution (such as rainfall, hunting and rural catch pressures), a spatially explicit population dynamic model was built. This model was then used to assess ecological and economic co-viability of several sources and sinks spatial arrangements, under conservation and socio-economic constraints. The three constraints included: minimum viable population in the reserve, minimum meat production for local communities and realistic quotas for hunting operators in safari areas.

**Results and discussion**

Our projections suggest that the current spatial configuration of the Hwange National Park permits the co-existence of the conservation objectives within the protected area, and the elephant sustainable use by humans on the peripheries. Other source-sink configurations were also investigated to reconcile both conservation and development dimensions. This study proposes a conceptual and discussion framework to assess management options in a context where spatial heterogeneity can allow sustainable harvesting strategies.

**Keywords:** *Loxodonta africana*, bio-economic modelling, protected area, co-viability, CBNRM

**Haase Peter****Biological response on river rehabilitation - Do rehabilitation measures increase biodiversity?**

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Contributed oral session O18, Ecological restoration

Within the last years, the ecological and socio-economical meaning of rivers moved increasingly into the foreground. A recent study of the European Union reveals that on average 70% of European rivers fail the good ecological status demanded by the Water Framework Directive (WFD). Worldwide efforts have already been made to re-establish formerly degraded rivers and to improve impoverished aquatic communities. It is often expected that organisms will resettle rehabilitated river sections after re-establishing near natural conditions in terms of habitat diversity. However, until today the biological effectiveness of rehabilitation measures in terms of increasing biodiversity is still unclear. In our study we performed for the first time simultaneous investigations on the response of fish, benthic invertebrate and aquatic macrophyte communities to river rehabilitation at 25 sites in Germany using a space for time substitution approach. The use of highly standardized methods allowed for the first profound examination of this topic. On average, rehabilitated stretches were 1.5 km long and monetary costs amounted to 600,000 Euro per measure. Although hydromorphology and especially habitat diversity increased significantly following rehabilitation, a positive organismal response was barely detectable. EU-WFD conform assessment results of fish communities showed an improvement in only one third of all cases, while benthic invertebrates and aquatic macrophytes showed almost no positive trend. Our results reveal that even several years after the implementation of rehabilitation measures, biodiversity still remains on a low level. This points out the necessity to consider impeding factors that counteract successful re-colonization events, e.g. missing source populations or high background levels of chemical load leading to a new, catchment area-based rehabilitation approach.

**Keywords:** freshwater biodiversity, river rehabilitation, monitoring, ecological status, biological response

**Haberl Helmut, Erb Karl-Heinz, Plutzer Christoph, Gaube Veronika, Krausmann Fridolin****Socioeconomic drivers of biodiversity: The utility of resource use indicators**

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Contributed oral session O19, Biodiversity indicators

**Background and goal**

Effective Policies to slow the rate of anthropogenic biodiversity loss should reduce socioeconomic pressures on biodiversity, either directly or through the modification of underlying socioeconomic drivers. The latter is currently hampered by a poor understanding of the interrelations between socioeconomic factors such as economic growth, technology, population or resource use and ecosystems/biodiversity.

**Materials and methods**

The drivers-pressures-states-impacts-responses (DPSIR) scheme is used to guide interdisciplinary research seeking to understand interrelations between socioeconomic drivers and biodiversity change. We discuss the utility of indicators for socioeconomic use of biophysical resources as materials, energy and land (socioecological metabolism) in this context. The "human appropriation of net primary production" (HANPP) is presented as an indicator of pressures on biodiversity. HANPP indicates land-use intensity by measuring the human impact on trophic energy flows in ecosystems.

### Results and discussion

Globally, HANPP in terrestrial ecosystems amounts to approximately 24% of the NPP of potential vegetation. We give an overview of empirical work on the interrelations between HANPP and biodiversity. Empirical evidence from several in-depth statistical case studies on the interrelation between HANPP and species richness is discussed. HANPP depends, inter alia, on population and economic growth, energy use, the agriculture-food-feed system and other important socioeconomic drivers. We review results from a national-level analysis of global socioeconomic biomass flows, recent cross-country analyses of the determinants of HANPP and studies of the potential impact of bio-energy development plans on future HANPP.

### Conclusion

The results suggest that the socioecological metabolism approach – material and energy flow analysis, HANPP – can be useful in helping to better understand socioeconomic drivers of biodiversity change.

**Keywords:** Socioeconomic drivers and pressures, Socioeconomic metabolism, Human appropriation of net primary production, Land-system change, Biophysical indicators of resource use

### **Hanitriniaina Andriamasimanana Rado, Grantham Hedley, Raminoarisoa Voninavoko** **Prioritising conservation management in Mahavavy-Kinkony Wetland Complex using decision support software and stakeholder participation**

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Contributed oral session O8, Conservation planning 1

Biodiversity in Madagascar is extremely vulnerable to human pressure. The president of Madagascar announced in Durban in September 2003 the commitment to increase the protected area coverage three-fold within 5 years. New protected areas are currently being implemented. As part of this process, one potential new protected area is the Mahavavy-Kinkony wetland complex, which contains many habitats for several globally threatened and congregational species. Our approach in designing the management of this protected area included both ecological and social science techniques. This included the application of the decision support software Marxan to prioritize areas for the protection of species. These species comprise of five taxa; birds, primates, fishes, bats and reptiles. We modelled the distribution of threatened animals using predictive models and expert knowledge. We also identified land cover in the region using remotely sensed imagery. For stakeholder consultation we included the willingness of the local community for the conservation of the natural resources by overlaying social information with the prioritisation results. Marxan has previously been used for national level planning in Madagascar for the prioritisation of new protected areas. However, this is the first time in Madagascar it has been applied for planning management zones within a protected area. Combining this software with stakeholder input has helped decide on the management plan of an important area for conservation by using a participative process.

**Keywords:** Conservation management, Protected Area, Local community, Biodiversity, Threatened species

### **Hatton Ian, Loreau Michel**

#### **What is regulating the diverse populations of large African mammals?**

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Contributed oral session O11, Biodiversity and ecosystem functioning 2

The mechanism of regulation of animal populations is fundamental to understanding their response to disturbance, and their impacts on the biodiversity of lower trophic levels. The Serengeti and Ngorongoro Crater ecosystems in East Africa are among the longest continuously studied systems and their population regulating mechanisms are perhaps telling of other terrestrial systems with large mammals. We present an analysis of forty years of population data for carnivores (lions and hyenas) and herbivores (buffalo, wildebeest, zebra and gazelle), as well as long-term grass and rainfall estimates, by testing various food-web models of animal interactions. Each model hypothesizes different regulating factors including top-down or bottom-up control, behavioural attributes and the relative strength of their respective influence. These mechanisms are modelled using different functional response relations between adjacent trophic levels, yielding very different predictions depending on their specification. Our results reveal some striking characteristics of this unique food web. In contrast to prevailing theory of trophic cascades, and supporting more recent findings, the behaviour of African animal groups can overwhelm evidence for strong trophic interactions. We discuss implications for community stability and ecosystem functioning over different time-scales, particularly the possible trade-off between short-term productivity and longer-term stability. Finally, we present future directions for research of large mammal populations in the context of biodiversity conservation and reserve management.

**Keywords:** population regulation, food webs, ecosystem functioning, community stability, biodiversity

**Heip Carlo**, Soetaert Karline, Weaver Phil

**Marine biodiversity and ecosystems at the European margins: results from the HERMES project**

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Contributed oral session O15, Analysing patterns and trends

Over the last five years our knowledge and understanding of marine ecosystems at the European margins of the Atlantic Ocean and the Mediterranean Sea has increased enormously due to efforts in the European Integrated Project HERMES (Hot Spot Ecosystems at the Margins of European Seas). In this project of over 100 M a large effort by the major European marine institutes was devoted to the description of special ecosystems, such as cold water coral reefs, mud volcanoes, submarine canyons and cold seeps. In these studies, new methodologies were used which allowed detailed observation as well as experimentation in hitherto unknown or unstudied habitats. Many new species and species assemblages were discovered and the ecology and biogeochemistry of these special habitats was studied for the first time. A summary of these results will be presented, showing environments and communities which are unlike anything found on land. Also the link between biodiversity and ecosystem functioning of the deep sea will be highlighted. Knowledge from this project is now being used for governance issues, such as the regulation of deep sea fisheries and the protection of marine areas beyond national jurisdiction.

**Keywords:** Marine, Margin, Ecosystem, Atlantic, Mediterranean

**Henriksson Rebecka**, Gordon Line, Lindborg Regina

**Scenarios of future ecosystem services and land use in an agricultural dominated area of KwaZulu-Natal, South Africa.**

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Contributed oral session O12, Drivers of biodiversity 2

**Background and Goal of Study**

South Africa is perhaps one of the most dynamic and changing countries, being a relatively new democracy under development, with large inequalities in wealth and land ownership, besides being largely impacted by HIV/aids and land degradation. The upper Thukela River basin in KwaZulu-Natal, South Africa, is an agriculture dominated landscape, consisting of small-scale and large-scale farming (crop production and grazing lands), forests, protected areas and urban settlements. We applied a scenario planning approach to this region to explore how land use, land cover, and ecosystem services could change in alternative ways in the future. These scenarios can be used to create more robust policies for future management of agriculture and other ecosystems in the region.

**Methods**

Semi-structured interviews were performed to understand what drivers of change are important for the local resource users (farmers and conservationists) in the study area today. These drivers were discussed with a wider group of stakeholders (e.g. researchers, policy makers and resource managers) during a scenario building workshop. The scenarios were further edited and later tested for consistency and plausibility by stakeholders. Analyses of land use and ecosystem services in the different scenarios are currently under construction. Maps and manipulated photographs will illustrate land use and ecosystem services for each scenario.

**Results and Discussion**

Development, investments, and enforcement of law and agreements were identified as key drivers of future land use change in this area. The alternative scenarios capture three different combinations of these key drivers and discuss the implications of other drivers such as agricultural practices, infrastructure, tourism, population dynamics, equality, health and livelihoods. Current analyses point toward changes in land use across all three scenarios but with different ecosystem services being the most important.

**Keywords:** Scenarios, Agricultural Landscapes, Ecosystem Services, Land Use Change, South Africa

**Hernández-Hernández Tania**, Martínez-Meyer Enrique, Magallon Susana

**Origin and evolution of succulent plant diversity in Caryophyllales**

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Contributed oral session O6, Biological diversification

**Background and goal**

Rapid environmental changes have been postulated as ecological triggers of evolutionary radiations that result in a concentration of spe-

cies diversity in particular clades. Such is the case of several xerophytic lineages distributed in arid regions of presumably recent origin. Succulence is among the most evident morphological modifications that plant lineages can evolve as adaptive responses to aridification. Hence, succulent lineages provide an opportunity to study past evolutionary diversifications under climatic warming trends.

### Materials and methods

Caryophyllales is a group of flowering plants that includes several succulent lineages. Some reach their highest diversity under similar dry environmental conditions: Cactaceae in the deserts of N and S America, Didiereaceae in arid zones of Madagascar, and Aizoaceae in the Namib desert. We use original and published molecular data to infer phylogenetic relationships and ages for these lineages, and correlate them with local paleobiological events. We estimate their rates of phylogenetic diversification, in relationship to the timing of putative climatic triggers of radiation. In an ecological perspective, we use niche modeling to identify climatic variables most likely responsible for their distribution, and test for their ecological equivalence.

### Results and discussion

The succulent lineages of Cactaceae, Didiereaceae and Aizoaceae diversified recently. We provide their diversification rates, and the ecological particularities of the areas they inhabit. By comparing these results, we postulate hypotheses about the origin and evolution of each lineage in paleobiological and environmental contexts.

### Conclusions

Our study documents the evolutionary dynamics of particular plant lineages in response to past aridification processes. It also provides tools to identify geographical hotspots of Caryophyllales succulent diversity that might guide conservation priorities.

**Keywords:** aridification, warming trends, evolutionary radiation, molecular dating, niche modeling

## Heubach Katja, Hahn-Hadjali Karen, Wittig Rüdiger, Krohmer Julia

### **The economic importance of non-timber forest products for livelihood maintenance of rural communities in West African savannahs: A case study from Benin**

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Contributed oral session O1, Economics of biodiversity 1

Non-timber forest products (NTFPs) make a significant contribution to household income in rural African communities. Undertaking a livelihood approach focusing on multi-purpose useful plants our study first aims to elicit the degree of dependence on NTFPs of different households in Benin in order to identify their respective share in a household's total income and detect different livelihood strategies. Coevally, data on the economic value of the studied NTFPs is gathered by conducting market surveys as well as applying participatory rural appraisal techniques and simple choice experiments due to investigate individual preferences concerning both direct use values and cultural / spiritual values of the studied plant species. The results will reveal the unquestionably high importance of biodiversity provided by savannahs that has been largely discounted by local policy-makers deciding whether to shift long-standing forest into agricultural land. Findings will be used to assist with appropriate decision making.

**Keywords:** economic valuation, NTFPs, livelihood strategies, rural households, Benin

## Hiremath Ankila, Sundaram Bharath

### **Lantana removal and barriers to native species restoration in South Indian tropical deciduous forests**

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Contributed oral session O18, Ecological restoration

*Lantana camara* (hereafter, *lantana*) is one of the most ubiquitous invasive species in Indian forests today. Our findings from a South Indian forest show an eight-fold increase in *lantana* density in just the past decade. Efforts to remove *lantana* and restore native vegetation have had very little success. We investigated the underpinnings of *lantana*'s success and the barriers to native species restoration. We hypothesized that *lantana* has an advantage over native vegetation a) due to seed banks enriched with seeds of *lantana* at the expense of seeds of other species, and b) due to its ability to compete more effectively for belowground resources. We investigated these hypotheses within the context of a *lantana* removal experiment in a tropical deciduous forest in South India. Although *lantana* constitutes a large proportion of the total seeds in soils of *lantana*-invaded areas, there were also a considerable number of seeds of other woody species. However, *lantana*'s advantage may lie in its seeds being available year-round. We also planted seedlings of 5 native species and *lantana* into areas from which *lantana* had been removed to evaluate their relative competitive abilities. There was a high degree of browsing on newly

planted seedlings of native species but not on lantana. There was also very high mortality of seedlings of all species other than lantana within the first 6 months after planting; by 18 months barely 20% of these planted seedlings were still alive. It is possible that repeated browsing compounds the effect of drought stress, leading to the high seedling mortality observed. Thus, it is not the availability of seeds, but the ability of seedlings to establish, that is the barrier to the restoration of the native vegetation. It may be necessary to exclude large herbivores for the successful establishment of native vegetation following lantana removal.

**Keywords:** Lantana camara, restoration, invasive species, tropical dry forests, India

## **Hirsch Paul**

### **Making Space for Environmental Problem Solving**

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Contributed oral session O2, Biodiversity science and policy

#### **Background and Goal of Study**

The most pressing environmental problems have complex spatial dynamics that are not easily translated into policy institutions. The challenges are both scientific and, increasingly, political. At all scales, from the municipal to the multi-national, those involved in the design of institutions for managing spatially complex environmental problems may perceive important interests to be at risk if power is assigned to regional bodies based on ecological ways of structuring space. Unless accounted for, this may hinder the effectiveness that ecological insights can have in guiding environmental policy.

#### **Materials and Methods**

The study presented involves three years of participant observation and survey research centered on a public process of defining "regional water districts" for ongoing water management in the state of Georgia.

#### **Results and Discussion**

71% of the surveyed participants, regardless of politics or group affiliations, were in favor of adopting planning regions defined by watersheds. However, if respondents were asked to assume that regions would have the authority to "make and implement decisions," this number was reduced to 51%. In particular, respondents with strong "conservative" values and those located relatively upstream were less likely to favor regions based on watersheds. In the plan ultimately adopted by the legislature, watersheds played a secondary role to county lines and metropolitan demographics in the demarcation of water districts.

#### **Conclusion**

The results of this study indicate that interests and politics, rather than disparate understandings of the spatial nature of the problem, may be at the root of resistance to policy institutions that align with ecological understanding. This finding has important implications for the development of institutions for dealing with water issues at larger scales (i.e. between nations), as well as for other spatially complex problems such as climate change.

**Keywords:** Decision Making, Science and Policy, Watersheds, Spatial Planning, Complexity

## **Huettich Christian, Gessner Ursula, Keil Manfred, Fox Tobias, Schmidt Michael, Dech Stefan**

### **Remote sensing for mapping vegetation types and dynamics in savannah ecosystems of Namibia: Concepts for integrated vegetation diversity assessments**

German Aerospace Center / University of Wuerzburg, Department of Remote Sensing, Germany

Contributed oral session O21, Monitoring biodiversity

#### **Background and goal of study**

The evaluation of the recent status of biodiversity, regarding the landscape complexity and spatial heterogeneity in Southern Africa's savannahs is a major challenge for land management and conservation purposes. There is a need to develop integrated and flexible concepts for upscaling biodiversity assessments from local to regional scales. This study presents the suitability of vegetation mapping frameworks of a semi-arid savannah ecosystem using multi-scale remote sensing methods.

**Materials and methods**

In-situ botanical field samples of plant community patterns in the Namibian NE-Kalahari were integrated in an upscaling process using two satellite imagery resolution levels (Landsat, 30-m; MODIS, 232-m) to map the spatial distribution of the major vegetation types based on Random Forest classification. The mapping was performed using a flexible legend according to the FAO-UN Land Cover Classification System (LCCS). Additionally, percentage woody vegetation cover was derived in a multi-scale regression tree approach and the results were combined as additional information with the vegetation type map. Change detection analysis was investigated in the highly dynamic regions of NE-Namibia.

**Results and discussion**

Vegetation changes in the Kavango were characterized by dynamics of subsistence cultivation and subsequent succession states. The integration of phenological metrics was shown to be a significant feature for vegetation type classification in semi-arid regions.

**Conclusion**

The study results show the potential of remote sensing data to gain spatially explicit information on different vegetation states and to upscale field survey data. The use of a flexible map legend increases the potential and useful integration of environmental geodata for a broad user community. Satellite time series data may provide recent and significant land change indicators to be used for future land change monitoring initiatives.

**Keywords:** remote sensing, land cover, MODIS, LCCS, Kalahari vegetation types

**Huising Jeroen**, Cares Juvenile, James Kimenju, K.G. Saxena, Gnonhour Philippe, Franco Navvaro, Gede Swibawa, Peter Okoth, Joseph Mung'atu

**Using nematode functional group abundance as soil quality indicators in tropical agroecosystems**

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Contributed oral session O21, Monitoring biodiversity

Soil quality indicators and nematode abundance were characterized in a tropical agroecosystem to evaluate the relationship between soil quality indicators and nematode functional groups. Soil quality indicators were generated from principal soil properties; soil organic (SOC), total nitrogen (TN), extractable phosphorus (Ext. P), exchangeable calcium (Ca), Magnesium (Mg), sodium (Na) and soil texture (sand clay and silt). Principal component analysis (PCA) was used to summarize the variability in soil properties and provide the soil quality indicators (GSQIs). Identification of nematode into different genera was done using a centrifuge method followed by a classification into functional groups as outlined by Yeates Method 1993. The functional groups were identified include; omnivorous, bacterial feeding, substrate ingestion, animal predation, unicellular eucaryote feeding, dispersal or infective stages of animal parasites, Plant feeding. Canonical correspondence analysis indicated that different genera can be associated with soil properties. There was a strong relationship with p value of <0.001 between the nematode functional groups and the soil properties. For example; SOC and TN were closely associated with the bacterial and hyphal feeding functional group. Sedimentary parasites had a positive relation with Ext. P where their total abundance increased with high levels of Ext.P while low levels of sand were associated with low population of semi endo parasites. The bacterial and hyphal feeding nematodes indicated good soil quality because of their positive associated with SOC, an important soil variable that plays a key role in the structure of soil and nutrient retention and has been accepted universally an indicator of soil quality. This study demonstrated the potential of nematode functional groups as indicators of soil quality because different categories were associated with the principal soil nutrients.

**Keywords:** Nematodes, Soil Quality, Indicators, Distribution, Tropical Ecosystems

Imbach Pablo, **Locatelli Bruno**

**Synergies and trade-offs between local and global ecosystem services in Costa Rica**

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Contributed oral session O22, Managing for ecosystem services

**Background and goal of study**

Payments for ecosystem services aim at promoting land use practices that improve or maintain the provision of ecosystem services to the local or global community. In Costa Rica, a national program of payment considers four ecosystem services: biodiversity conservation, carbon storage, hydrological services, and scenic beauty. Targeting payments is a complex issue as it requires analyzing the synergies or

trade-offs between the different services. The study aims at assessing the spatial distribution of the four ecosystem services considered in the Costa Rican PES program and delivered by forests at the national scale.

### Materials and methods

The assessment of ecosystem services considers the capacity of ecosystems to produce a service and the presence of beneficiaries in the spatial area where the service flows. For each ecosystem service, we defined ecological and socioeconomic indicators describing the capacity of ecosystems to produce a service and the presence of beneficiaries. Using fuzzy logic, we mapped ecosystem services at the national scale and at different spatial resolutions.

### Results and discussion

The maps of ecosystem services show different priority areas for the four services. Synergies between different services can be identified in some regions, while other regions are characterized by trade-offs between local and global services. Synergies and trade-offs need to be studied at an adequate map resolution.

### Conclusion

This spatial assessment of ecosystem services enables investigating the spatial synergies or trade-offs between different ecosystem services and prioritizing sub national areas with different profiles of service delivery.

**Keywords:** ecosystem services, biodiversity, water, carbon, map

**Inauen Nicole**, Hiltbrunner Erika, Körner Christian

### Biodiversity responses to elevated CO<sub>2</sub> in glacier forefield plant communities

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Contributed oral session O14, Biodiversity and climate change

### Background and goal of study

Glaciers in the European Alps have lost around 40% of their originally glaciated area since 1850, due to climatic warming. The recently released glacier forefields are colonized by alpine pioneer species setting the scene for later successional stages. We hypothesized that rising CO<sub>2</sub> concentration will enhance plant growth in these high elevation communities in a species-specific manner, thus changing species diversity and species abundance.

### Material and methods

Nine glacier forefield species were exposed to an elevated CO<sub>2</sub> concentration of 580 ppm by in situ Free Air CO<sub>2</sub> Enrichment (FACE) in the Swiss Central Alps (2440 m a.s.l.). The responses in growth dynamics, peak season biomass and reproductive effort of two graminoid species, three herbs and four cushion plant species were analyzed by repeated non-destructive assessments and a final biomass harvest. Additionally, the leaf quality, non-structural carbohydrates (NSC) and nitrogen concentration as well as photosynthetic rates were measured.

### Results and discussion

After three seasons of CO<sub>2</sub> enrichment, none of the species has considerably been stimulated by elevated CO<sub>2</sub>, not even when nutrients were added in order to avoid the presumable nutrient limitation of the CO<sub>2</sub> response. Increased CO<sub>2</sub> concentration even slightly reduced plant growth in the graminoid species, although they showed a significant stimulation of leaf net photosynthesis by long-term exposure to elevated CO<sub>2</sub>. Leaf nitrogen concentration decreased in some herb and graminoid species.

### Conclusion

Our results indicate that these glacier forefield pioneers are either not carbon limited at current ambient CO<sub>2</sub> concentrations or their response to elevated CO<sub>2</sub> is constrained by feedback inhibition through a boost of soil microbial growth. Counter expectation, the effects on community composition and colonization dynamics in response to rising CO<sub>2</sub> levels are likely to be minor.

**Keywords:** mountain biodiversity, European Alps, climate change, FACE, growth

**Jabot Franck**, Chave Jérôme

**Integrating phylogenies in models of community dynamics with special reference to tropical forests**

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Contributed oral session O6, Biological diversification

**Background**

Phylogenetic relationships among coexisting species contain critical information for understanding how these species interact. Much effort has been made to use phylogenies for testing mechanisms of community assembly, but few attempts have aimed at integrating phylogenetic information in the modelling of community dynamics. Here we examine whether the neutral theory of biodiversity could provide a quantitative framework for the integration of evolutionary and ecological scales in models of community dynamics.

**Methods**

We tested the compatibility between phylogenetic predictions of the neutral model and 2000 published phylogenies. Then we developed a statistical method to infer the neutral parameters from data on species abundances and on their phylogenetic relationships. This method uses the Approximate Bayesian Computation (ABC) approach, which is new in ecology. We then applied our method to four tropical forest tree datasets.

**Results/discussion**

The neutral model predicts phylogenetic topologies which are compatible with most published phylogenies. We also found that phylogenies contain critical information which drastically changes the estimated neutral parameter values for tropical forest trees. A direct implication of these results is that regional pools of tropical trees should extend over continental scales to be compatible with neutral theory. In addition, the ABC approach presented here increases considerably the potential for investigating more complex models of community dynamics. We discuss extensions of our work to other speciation models and hypotheses of species non-neutral interactions. Such models could be used to predict biodiversity changes in mega-rich communities, together with the dynamics of their associated evolutionary heritage.

**Conclusion**

Our work attempts to integrate phylogenetic information into community modelling so that, on top of species dynamics, the evolutionary heritage that they sustain can become an object of prediction.

**Keywords:** Phylogeny, Community Modelling, Neutral Theory, Tropical Forests, Approximate Bayesian Computation

**Jesudasan Allwin**, Devy Soubadra, T Ganesh, R Ganesan

**Revisiting the 'successful' Integrated Conservation and Development Project (ICDP) in Kalakad-Mundanthurai Tiger Reserve, India**

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Contributed oral session O13, Conservation, conflicts resolution and development

**Background and goal of study**

The past two decades have witnessed a new conservation paradigm in the form of Integrated Conservation and Development Projects (ICDP). The ICDP in Kalakad-Mundanthurai Tiger Reserve (KMTR), India, being implemented since 1994, is projected to be very successful. Our aim was to evaluate the success of the project by examining the perspectives of villagers to see if the ICDP has positively influenced attitudes towards forest conservation and by examining other crucial aspects of the program.

**Materials and methods**

Sampling was conducted at the household level from nine villages where 224 randomly selected respondents were interviewed on aspects of the program and to assess their attitudes. Ordered Logistic regression was run to see which combination of variables best explained conservation attitude.

**Results and discussion**

There was no significant difference between conservation attitudes of those who received benefits from the ICDP than of those who had not. Villagers had rarely used the alternate biomass claimed to have been generated outside the reserve by the program. Contradicting the claim that the program is participatory, most of the villagers who had received benefits were not aware of the use of funds by the program.

The loans provided by the program were often not used for alternate livelihoods. There was no significant difference between income levels of beneficiaries and non-beneficiaries suggesting that the program may not have been successful in targeting just the lower income groups who are more likely to be directly dependant on the forest. Beneficiaries also seem to be failing to fulfill the duty of beneficiaries to report illegal activity.

### Conclusion

Though many of the villagers were aware of the purpose of starting the program and the number of beneficiaries has been increasing, the analysis of our data shows that the success of the ICDP implemented in KMTR as a conservation program is debatable.

**Keywords:** Integrated Conservation and Development Project, Kalakad-Mundanthurai Tiger Reserve, Southern India, Conservation attitude, Perspectives of forest fringe villagers, Project evaluation

## **Johst Karin, Van Teeffelen Astrid J. A., Drechsler Martin**

### **Tradeoffs in conservation planning for dynamic landscapes**

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Contributed oral session O8, Conservation planning 1

### **Background and goal of study**

Many species live in dynamic landscapes and are adapted to habitat destruction and regeneration which are typical for these landscapes. However, global change (climatic, land-use, etc.) may alter natural landscape dynamics. The last decades have shown that many species are not able to cope with these changes and adequate conservation plans are needed to address these threats. Concerning dynamic landscapes, there is a lack of knowledge in two directions: (1) can traditional rules of network design in static landscapes be transferred to dynamic landscapes, and (2) can increasing landscape dynamics be compensated by improvements in static landscape attributes, such as habitat connectivity.

### **Materials and methods**

We study these two questions analysing tradeoffs between different landscape attributes with an analytical formula we developed for the rapid assessment of metapopulation viability in dynamic landscapes. First, we consider the frequently studied trade-off between the connectivity and the number of patches in static versus dynamic habitat networks. Second, we study the tradeoffs between these two landscape attributes and the level of landscape dynamics.

### **Results and discussion**

We investigate the functional forms of these tradeoffs and how they depend on the attributes of the species to be protected. This allows us to derive conclusions for conservation management.

### **Conclusion**

We show that efficient biodiversity management differs between static and dynamic landscapes so that traditional rules of static network design cannot be applied straightforwardly in dynamic landscapes. However, we show that increasing landscape dynamics can be compensated by improvements in static network attributes. Thus, the consideration of landscape dynamics in conservation planning is indispensable.

**Keywords:** landscape dynamics, management, biodiversity conservation, global change, ecological, economic modelling

## **Joubert Lize, Samways Michael**

### **Conservation value of large-scale ecological networks in afforested areas in South Africa**

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Contributed oral session O17, Conservation planning 2

The current biodiversity crisis requires measures for mitigating further biodiversity loss. An understanding of the different spatial scales over which biodiversity can be measured is important for practical biodiversity conservation. The South African forestry industry recognizes that there is a loss of biodiversity at the spatial scale of patch, while mitigating this loss at the larger scale of landscape by implementing large-scale ecological networks (ENs). Currently over 500 000 ha of land has been devoted to these ENs. However, the degree to which these ENs conserve biodiversity has never been fully assessed. This forms the basis of this investigation. This study builds on previous research to determine how representative ENs are of grassland biodiversity in comparison with that in reserve areas. The study was

conducted at two elevations in KwaZulu-Natal, South Africa: the Lowlands next to iSimangaliso Wetland Park, and the Midlands adjacent Impendle Nature Reserve. A systematic approach involved five taxa (birds, large mammals, plants, fungi and butterflies) in grassland areas within an EN and similar habitat in the adjacent nature reserve, using field observations, while controlling for different disturbance regimes. Depending on the disturbance regime, the biodiversity in the Lowland ENs reflect a subset of the biodiversity found in iSimangaliso Wetland Park. The Midlands Ecological Networks accurately represent the biodiversity in the Impendle Nature Reserve, although the species composition is markedly different in areas where communal grazing is not controlled. In conclusion, ENs clearly have considerable conservation value, but this value runs the risk of being jeopardized by the cascading effects of different disturbances (e.g. overgrazing) that can take place within the ENs.

**Keywords:** South Africa, Ecological Networks, biodiversity, spatial scale, forestry

**Jouseau Claire, Jiguet Frédéric, Pavoine Sandrine, Porcher Emmanuelle**

**The impacts of land-use and land management practices on French avian functional diversity**

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Contributed oral session O11, Biodiversity and ecosystem functioning 2

### Background

In recent decades, agri-environmental schemes have been widely implemented across Europe with unknown consequences for bird species. Continued anthropogenic pressures on bird populations lend increasing importance to understanding the implications of these schemes for conserving avian diversity and the services these assemblages deliver to society. In this study, we evaluate spatial and temporal trends in the functional diversity of French avian assemblages in order to assess the effectiveness of several common agri-environmental schemes and the possible consequences these diversity trends have for agricultural production, pest management, and avian biomass.

### Methods

Avian assemblages included the 105 most common species monitored by the French Breeding Bird Survey in 1229 sites across rural France. For each species, five composite traits based on morphological characteristics were calculated and found to be well-correlated with diet, foraging behaviour, habitat preferences, and reproductive output. Functional diversity was quantified using three metrics: functional richness (the volume of multi-dimensional trait space occupied by each assemblage), functional evenness (the regularity of the distribution of species within trait space), and functional divergence (a measure of the distribution of species abundance within trait space).

### Results:

Changes in species composition do not necessarily result in changes in trait composition and ecosystem functioning. In addition, increasing species richness does not necessarily increase functional richness as generalist species tend to occupy similar regions within trait space and specialist species, which tend to contribute novel trait combinations, are rare. Therefore, the contributions of various species to the functioning of ecosystems are not equivalent and the loss of a few species from an assemblage can result in severe contractions in functional richness and the ecosystem services this trait space represents.

**Keywords:** functional diversity, avian assemblages, morphological traits, agri-environmental schemes, ecosystem services

**Kark Salit, Levin Noam, Grantham Hedley, Possingham Hugh**

**The importance of regional collaboration for biodiversity conservation:**

**What can we learn from the Mediterranean Basin?**

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Contributed oral session O17, Conservation planning 2

While many conservation programs are applied at national and sub-national scales, the importance of global and regional scales in conservation coordination is growing. Increasingly, both government and non-government organizations (NGOs) spend resources outside their country of origin, reflecting an internationalization trend in conservation. International programs are often costly, complicated and require additional logistics and resources compared to local programs. Given the need to maximize returns on investment within the very limited conservation budget, it is therefore crucial to quantify how much more biodiversity can be protected by coordinating multi-national conservation efforts when resources are fungible. Previous studies that compared different scales of conservation decision making addressed the variability in biodiversity measures, but ignored the spatial variability in the threats to biodiversity and the cost of actions. Here, we developed a simple integrating metric, the biodiversity-human impact metric (BHM), which enabled us to take into account both threats to biodiversity and the

cost of conservation. We focused on the Mediterranean Basin, one of the Earth's richest biodiversity hotspots, which encompasses over 20 countries. We discovered that, for freshwater fish, amphibians, and reptiles, in order to achieve the same conservation benefits, one would need substantially more money and a larger area for conservation if each country acts independently compared with coordinated action across the whole Mediterranean Basin. The initiative declared in the recent Paris Summit for the Mediterranean may form a political basis for this complex coordination. However, because most conservation priority areas selected for these vertebrates were located in the European Union (EU) Mediterranean countries, a partly coordinated solution incorporating only the EU countries was almost as efficient as the fully coordinated scenario across the whole Mediterranean Basin. As such, it can provide an efficient compromise until a fully coordinated plan is feasible.

**Keywords:** Mediterranean Basin, conservation, biodiversity, regional collaboration, vertebrates

### **Kartikasari Sri Nurani, Rixecker Stefanie**

#### **Your biodiversity in my backyard: conservation-development disconnections in Sulawesi, Indonesia**

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Contributed oral session O13, Conservation, conflicts resolution and development

The biodiversity-rich tropical forest of Gorontalo in Sulawesi, Indonesia is internationally important as the last stronghold for much of the island's endemic and endangered wildlife. Much of the forest was established as protected areas (PAs) to demonstrate Indonesia's commitment to global biodiversity conservation. The same forests are also important as fruit baskets for their surrounding communities. Consequently, the management of PAs has been fraught with social and economic problems that are rarely addressed by conservation managers. This paper is based upon the main author's qualitative study of exploring stakeholders' perceptions regarding the values of natural forests and its conservation and the drivers of deforestation. The study involved interviewing 110 participants from six distinct stakeholder groups, from both governmental and non-governmental sectors. Using an analytical framework of political ecology of deforestation, some critical disconnections between the conservation policy and the reality of the local forest users became apparent. Participants revealed their high appreciation of the forests' economic and environmental functions but they voiced profound concerns over local extractive activities that directly caused forest degradation. The perceived main causes of the activities were institutional failures in forest management, poverty, and conflict of development policies. At the core of these is a widespread and persistent failure to properly understand, quantify, or value the goods, services, functions and capital value of the natural forests, at both local and national levels. A key finding of this study is that the conservation of biodiversity cannot be considered in isolation from the broader patterns of forest resource use and the socio-economic and political contexts where people carry out their lives. The findings suggest that the centrally-controlled and preservationist conservation approach has been ineffective in achieving conservation

**Keywords:** biodiversity conservation, environmental policy, rural development, protected area management, Indonesia

### **Kaushal K K**

#### **Nurturing joint forest management**

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Contributed oral session O1, Economics of biodiversity 1

India has embarked upon a community involvement process to restock the state-owned forests through an Indian version of community forestry called Joint Forest Management (JFM). People's participation is structured through specially established local village level institutions called Village Forest Councils (VFCs). But the success of the Joint Forest Management program lies in the provision of alternative livelihoods to woodcutters and grazers. This article presents how the forest department of a Southern state of India devised a potent tool of microfinance promotion by VFCs for weaning those who are dependent on the forest while implementing a Japan Bank for International Cooperation funded 100 Million US \$ Joint Forest Management Project.

Each VFC is provided a grant of 12000 US \$ for the provision of productive loans to the forest dependents. Presently, extending credit is the main financial activity of the VFC. But the term Microfinance has been applied as some VFCs arrange for insurance of members and purchased cattle. The collection, processing and sale of Non Timber Forest Products is also done by the VFCs. A field study was undertaken in 27 program villages in the Tamilnadu state. Recovery and recycling of VFCs' fund were rated on a scale of 0 to 1. Forest protection and regeneration status of each programme village were also rated on a scale of 0 to 1. Data showed that there is a direct correspondence between the microfinance working and the forest protection.

The paper concludes that the success of Joint Forest Management is dependent on and is directly linked to the provision of microfinance to villagers through a people's representative body — the Village Forest Council.

**Keywords:** Joint Forest Management, Microfinance, Forest dependents, Village Forest Council, Forest protection

Kok Marcel, Tyler Stephen, Prins Anne Gerdien, Pinter Laszlo, **Rob Alkemade**  
**Mainstreaming ecosystem goods and services in international policies: Making the connections and showing the options**

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Contributed oral session O22, Managing for ecosystem services

This paper is a response to the recommendations of the Global Biodiversity Outlook-2 and the Millennium Assessment, as well as to calls from the Convention on Biological Diversity (CBD) that much broader consideration must be given to the strengthening of Ecosystem Goods and Services (EGS) in relevant national and international policy domains. The evidence available to date suggests that to deal effectively with the provision of EGS at the local scale, decision-makers will need to employ coherent policy levers across different domains and levels of governance. In this paper the linkages between the provision of EGS in developing countries and international policies as well as multilateral organizations are made. The paper pays particular attention to inter-linkages and implementation mechanisms through which international policies have direct effects on national and local decision-makers. The research especially looks at drylands, tropical forests and coastal areas in the tropics. The primary focus of the paper is on the analysis of relevant international policy domains and identification of concrete policy options in i) development policies; ii) trade; iii) climate policies and iv) international financial institutions. For these policy domains it is analyzed why mainstreaming EGS is necessary to reach development goals; what the relevant policy tracks are and what is lacking from an EGS perspective; how implementation in national policies can take place as well as cross-compliance; which private/voluntary initiatives are relevant; what important tools and mechanism for mainstreaming can be and what the supportive role of CBD and CCD can be. The paper provides an overview of possible mainstreaming tools and ends with some conclusions about how the role of EGS in current global environmental governance reforms can be strengthened.

**Keywords:** International policies, Mainstreaming EGS, Development policy, trade policy, climate policy

**Kongor Raphael Y.,** Horn Anne, Krug Cornelia B., Esler Karen J.

**Combined floristic and functional approaches for the sustainable conservation of the highly transformed, species rich renosterveld shrubland of the fynbos biome**

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Contributed oral session O7, Biodiversity and ecosystem functioning 1

Due to habitat transformation renosterveld, a species-rich Mediterranean shrubland of the Cape Floristic region, is one of the most endangered vegetation types world-wide. Conservation authorities urgently require guidelines to optimize meagre budgets for sustainable effects. Information on minimum viable fragment size, edge effects and the value of corridors is particularly crucial. To provide this information, a three-pronged survey design was used to study floristic and plant functional type (PFT) composition in (1) four fragments of a range of sizes from large to small, (2) five large fragments from edge to interior and (3) riverine and drainage line corridors between fragments. The effect of fragment size on species richness was not unequivocal, which is potentially due to variations in the grazing regime. Grazing also had a strong effect on PFTs, however, they also responded strongly to fragment size as such. Sensitive traits included dispersal and pollination modes, as many geophytes showed highly specialized pollination mutualisms. Fragments from 100 ha were most likely to retain their full functional diversity. Our study showed further that edge effects could potentially reach 200 m or even further into fragments. This particularly applied to the characteristic and species rich petaloid monocotyledons as well as to fern species. Corridor results were ambiguous, but indicated that many indigenous species could use even heavily invaded corridors and might thus improve pollinator and disperser movement between fragments.

We conclude that a dual approach is necessary to prevent the looming settlement of a potential extinction debt. First, measures to allow for pollinator and disperser movement between fragments such as provision of corridors need to be implemented. In cases where this is impossible, transplanting plants might be necessary to prevent local extinctions. Second, fragments should ideally be restored to at least 100 ha in size and 800 m width.

**Keywords:** fragmentation, area effects, edge effects, plant functional types, conservation planning

**Kotschy Karen,** Rogers Kevin

**Functional diversity and resilience of riparian vegetation under different land management**

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Contributed oral session O12, Drivers of biodiversity 2

**Background and goal of study**

Riparian zones in savannahs provide many important ecosystem services, including the provision of food for animals, erosion control, carbon storage and nutrient cycling. In communal lands in South Africa, riparian zones are also utilised by people, for food, fuel wood, construction materials and livestock grazing. It is widely accepted that riparian ecosystems should be managed in a way that maintains or enhances their resilience, to ensure the continued provision of these services. It is not at all clear, however, how this should be done. This study aims to improve our understanding of how resilience is generated, through assessing patterns of functional diversity and redundancy, and to determine the impact of human activities on riparian ecosystem resilience.

**Materials and methods**

We analysed the compositional and functional diversity of woody riparian vegetation in three areas of the Sand River catchment under different land management regimes: the Kruger National Park, Sabi-Sand private reserves, and adjacent communal lands. Diversity measures considered all three of the components of diversity (variety, balance and disparity).

**Results and Discussion**

The study highlights the importance of small drainage lines as reservoirs of biodiversity. In these small streams, neither compositional nor functional diversity was negatively impacted by communal land management practices; in fact both were enhanced, contrary to the expectation. Along the main river, however, this pattern was reversed, with higher diversity within the protected areas. Overlap in functional traits between dominant and minor species indicated a high degree of functional redundancy. While patterns of redundancy differed for different ecosystem functions, overall resilience was high in both the communal and protected areas. The implications of this for conservation policy and practice will be discussed.

**Conclusion**

Land management practices in communal lands do not necessarily decrease functional diversity or resilience.

**Keywords:** functional diversity, resilience, riparian, conservation, human impact

**Krug Rainer M.,** Roura-Pascual Núria, Richardson David M.

**Towards more efficient management of invasive alien plants: Spatial prioritisations**

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Contributed oral session O17, Conservation planning 2

**Background and goal of study**

Managing invasive alien plants (IAPs) is usually a triage, constrained by human and financial resources. Limited resources do not allow for the complete eradication of all IAPs in the whole managed area. It is thus essential to use an objective and transparent prioritisation approach. However, even the most objective and transparent prioritisation does not guarantee effectiveness, and success, measured in time required until an IAP is eradicated or decimated to a given level, can only be assessed over time.

**Materials and methods**

To be able to compare the effectiveness of different prioritisation strategies and to select the most effective one, we developed a spatio-temporal simulation model (SpreadSim) to simulate the spread of IAPs over time. Simulations were run over 100 years, during which one prioritisation strategy was used, and the amount of the area cleared was constrained by financial resources. SpreadSim incorporates spatial as well as non-spatial information, includes fire spread simulation, the spread of the IAPs and costs of clearing.

**Results and discussion**

We will show that the prioritisation and optimisation are highly dependent on the underlying landscapes, but that certain generalisations can be drawn for both. Implications and data requirements for the usage of this methodology in management will be discussed.

**Keywords:** alien plants, management, spatial prioritisation, optimisation, simulation model

**Lampo Margarita**, Mariella Márquez, Nava-González Francisco, Sánchez Dinora A., Calcagno Marina  
**Frogs are able to clear infection from *Batrachochytrium dendrobatidis* under temperature optimum conditions for pathogen growth**

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 Contributed oral session 09, Global environmental change and health

**Background and goal of study**

Chytridiomycosis, a disease caused by the fungus *Batrachochytrium dendrobatidis* (Bd), has devastated some amphibian populations while leaving others unaffected. The drivers of chytridiomycosis epidemics remain poorly understood. However, host susceptibility varies between species; some frogs die within weeks of exposure while others develop no clinical signs. Possible explanations include 1) the refractoriness to infection, 2) the host capacity to coexist with the pathogen or 3) a post-infection response that allows hosts to clear the infection. To elucidate the mechanism of disease resistance in two frog species, *Hypsiboas crepitans* and *Mannophryne collaris*, we followed the course of infection in experimentally exposed frogs.

**Materials and methods**

Frogs were assigned to one of two groups, treatment or control. Treatment frogs were inoculated with standard doses of in vitro cultured Bd while control frogs were exposed to sterile culture media. Swabs were used to collect skin samples from control and treatment frogs prior to Bd exposure and at day 28, 38, 45, 53 and 62 post-exposure. Numbers of zoospores collected by swabs were estimated by rt-PCR assays.

**Results and Discussion**

Most exposed specimens of *H. crepitans* and *M. collaris* showed evidence of infection at 28 days after exposure. The intensity of infection in *M. collaris* remained constant throughout the experiment; none of them died or recovered from the infection. On the contrary, the infection intensity declined in *H. crepitans* after day 28 and, by the end of the experiment, all frogs had recovered from the infection.

**Conclusion**

*H. crepitans* and *M. collaris* respond differently to Bd infection. Under optimal temperature conditions for in vitro pathogen growth, the infection in *M. collaris* may persist for months while *H. crepitans* are able to recover from the infection within weeks of exposure. The ability of *H. crepitans* to rapidly recover from the infection may explain its natural low prevalence of infection in the Venezuelan Andes.

**Keywords:** Amphibian declines, chytridiomycosis, diseases, pathogens, *Batrachochytrium dendrobatidis*

**Lange Charles**, Kristensen Thomas, Madsen Henry  
**The impact of anthropogenic disturbances on freshwater gastropods of L. Victoria, Kenya. Implications for biodiversity conservation and management of potential snail-borne diseases.**

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 Contributed oral session 09, Global environmental change and health

**Background and goal of study**

Anthropogenic disturbances are currently the most critical challenge to conservation of wetlands and their biodiversity. Owing to escalating unemployment coupled with climate change impact resulting in prolonged droughts, many people are commonly moving to wetlands in search of water and income sources like fishing and water. In L. Victoria, this has led to the development of many fishing villages along the lake shore which are a major source of anthropogenic disturbances in the lake. The impacts of these fishing villages associated with anthropogenic disturbances on biodiversity like gastropods and the implications for their biodiversity as well as snail-borne diseases remain to be described. The present study sought to investigate the diversity patterns of freshwater gastropod at disturbed fishing beaches and at National park sites least disturbed by humans of L. Victoria, Kenya.

**Materials and Methods**

Standardized snail sampling methods were employed as described by Lange (2005).

**Results**

A total of 15 species and 133984 specimens were recorded. One species (*Physa acuta*) was a new record to Lake Victoria and an invasive

species. Comparatively higher snail diversity was reported in the undisturbed habitats than in the disturbed habitats. Three species were only recorded from undisturbed habitats whereas one was only reported from the disturbed habitats. The rest of the species also showed the tendency to be associated with one kind of habitat. Those acting as intermediate hosts in snail-borne diseases showed a higher preference to the disturbed habitats compared to the least disturbed habitats.

### **Discussion and Conclusion**

The study portrays that anthropogenic disturbances are likely to cause a decline in the regional freshwater gastropods creating a conservation concern. Second, such influences result in the building of high densities of potential intermediate hosts of schistosomiasis.

**Keywords:** Freshwater gastropods, *L. Victoria*, Anthropogenic disturbance, biodiversity, Kenya

## **Le Prestre Philippe**

### **Global biodiversity governance after 2010**

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Contributed oral session O16, Biodiversity governance

To what extent has the convention on biological diversity (CBD) laid the ground for a new kind of international biodiversity governance and what are its prospects after the 2010 mark? This paper takes a look back at the achievements of the CBD since its entry into force and examines the challenges it, and biodiversity governance in general, face after 2010, notably: the governance of the CBD regime, issues that impede progress, the coordination with other regimes, multilevel governance, and implementation. It then argues that one of the problems has been the thinking about governance essentially in centralized terms rather than exploring the contours of an effective system of decentralized biodiversity governance.

**Keywords:** CBD, Governance, 2010, International, Challenges

## **Le Roux Xavier**

### **A new tool to better link biodiversity research and society in France: the Foundation for biodiversity research - FRB**

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Contributed oral session O2, Biodiversity science and policy

The FRB has been set up in February 2008 by the Ministers for Ecology and Research and the 8 national research institutes working on biodiversity. Its main purpose is to bring together public research bodies, the corporate sector involved in biodiversity management, environmental organizations, and business, in order to meet the biodiversity research challenge. FRB is the National Committee for DIVERSITAS since March 2008. For one year, the FRB has supported several actions aiming at promoting biodiversity research and strengthening its link with society:

- Development of the national biodiversity research strategy, by the FRB scientific council in connection to stakeholders;
- Launch of 4 calls for proposals (3 national calls ranging from blue sky research to cooperation between science and business; and active participation for the launch of one European call);
- Use of the FRB stakeholders committee to develop an interface between science, the business world, and civil society; promotion of innovative biodiversity research activities in the areas of biodiversity indicators and observatories, territorial arrangements, the values of biodiversity, legal issues, training, expertise and communication;
- The transfer of knowledge and the mobilisation of expertise through (i) the publication of books such as "Integrating biodiversity into business strategies: a biodiversity accountability framework" (Houdet et al. 2008), (ii) the creation of a database on scientists and stakeholders working in the field of biodiversity, and (iii) the launch of a web site on biodiversity and biodiversity research for scientists and the public audience;
- Organization of scientific events, in particular the European "Biodiversity and Industry" conference, and the EPBRS conference under the French presidency of the EU;

These actions illustrate how a national science/society interface such as FRB can promote biodiversity research and innovation through building collective efforts.

**Keywords:** foundation, science, society interface, research strategy, communication, expertise

**Lockie Stewart**, Benares Carmen, Carpenter David, Freckleton Rebeka

**Biodiversity, markets and livelihood outcomes in the uplands of Negros Occidental, the Philippines**

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Contributed oral session O3, Agrobiodiversity

**Background and Goal of Study**

Ecosystem services provided by biodiversity underpin agricultural production, yet a lack of livelihood options for small farmers is often a factor in biodiversity loss; driving deforestation and the associated loss of endemic species along with the displacement of traditional crop varieties. This research thus examined the contribution of biodiversity management to the livelihoods of small farmers living in the proximity of the North Negros Forest Protected Area.

**Methods**

A structured livelihood and biodiversity management survey was administered to 347 farm households in six upland communities. Follow-up interviews were conducted with farmers and community leaders to share, clarify and add to results.

**Results and Discussion**

Most households lived in extreme poverty with average daily incomes of US\$5c per member and difficulties in sourcing sufficient food 2-4 months/year. Planned biodiversity management activities focussed on the protection and the rehabilitation of forested slopes, the utilization of locally endemic plant varieties, the development of imported plant genetic resources, biosecurity and the use of organic production methods. 89% of coffee, 84% of fruit, 69% of vegetables, 43% of maize and 29% of rice were grown organically; primarily to reduce costs but also to improve soil health and to access higher value markets for local, organic and/or fair trade produce. Access to such markets helped farmers to stabilise incomes and to conserve natural resources. While their contribution to farm productivity and incomes was thus incremental, farmers were confident that the benefits of more biodiversity-friendly practices were also cumulative and would lead to better long-term livelihood outcomes.

**Conclusion(s)**

Protecting, enhancing, and exploiting the ecosystem services provided by biodiversity reduced the ecological and financial risks faced by upland farmers in Negros Occidental. However, the need remains to address seasonal food insecurity and to increase cash incomes.

**Keywords:** Agrobiodiversity, Markets, Protected areas, Organic agriculture, Livelihoods

**Lohmann Dirk**, Falk Thomas, Rossmannith Eva, Tietjen Britta, Kirk Michael, Jeltsch Florian

**How do land reform beneficiaries decide on resource use? Empirical experiments based on an ecological-economic modelling approach**

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Contributed oral session O2, Biodiversity science and policy

**Background and goal of study**

The ongoing degradation of savannah ecosystems has significant long-term ecological and economic consequences. Climate change, the socio-economic background of resource users, the impact of institutional (dis-)incentives, and resulting land use strategies contribute to this process. In our study we assess the implications of land use changes due to the Namibian land reform process, where farmers previously used to a communal land management setting, have to adapt to a commercial framework. We investigate factors critical to the decision making process – in particular regarding land use intensity – and how this relates to the state of the ecosystem.

**Materials and methods**

We used an eco-hydrological model to simulate the vegetation dynamics in the Omaheke region/Namibia dependent upon environmental conditions. By dynamically linking this model to an agent-based economic model we are able to include decisions of land users. The ecological-economic model was used (1) to identify optimal land use strategies under different environmental, ecological and socio-economic conditions by running simulation experiments and (2) as a tool to conduct empirical role plays in order to deepen our understanding of the rationale of land reform beneficiaries.

**Results and discussion**

The empirical data showed that farmers tend to react strongly on short-term financial signals. In contrast, model simulations suggest that a long-term strategy of adaptation to the state of the vegetation and the variability in rainfall can improve long-term economic as well as ecological outcomes.

**Conclusion**

We conclude that mal-adapted management strategies as well as financial constraints lead to sub-optimal outcomes. Our approach produces context specific information for stakeholders as a means to support their search for solutions to achieve biodiversity maintenance as well as rural development objectives.

**Keywords:** Rangeland management, Ecological-economic model, land reform, savannah, companion model

**Lohmann Lucia****A phylogenetic approach to understanding contemporary diversity patterns in Bignoniaeae (Bignoniaceae)**

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Contributed oral session O6, Biological diversification

**Background and goal of study**

Bignoniaeae is a conspicuous component of the neotropical flora; this large (360 spp.) angiosperm clade contains more species of woody vine than any other neotropical group. Representatives of Bignoniaeae occur in many of the major ecological zones in the neotropics and exhibit considerable diversity in reproductive and vegetative morphology. The ecological importance of Bignoniaeae, combined with its broad distribution and morphological diversity make this an excellent model for investigating patterns of neotropical biodiversity.

**Materials and methods**

We used a broad-scale molecular phylogeny to investigate patterns of diversity in Bignoniaeae. Specifically, we evaluate geographic range and morphological data in the context of this phylogenetic framework, exploring biodiversity at differing geographical scales and possible evolutionary explanations for these patterns.

**Results and discussion**

The phylogenetic framework provides important new insights into the development of Bignoniaeae diversity. Although the group is currently most diverse in Amazonia, it seems most likely that Bignoniaeae arose in the coastal forests of Eastern Brazil and that there have since been multiple, independent transitions between ecological zones; these independent events are temporally asynchronous. Similarly, phylogenetic reconstructions indicate that key ecological and morphological traits have arisen on multiple occasions that are, in some cases, correlated with a specific habitat or other ecological change. These insights suggest that patterns of modern diversity in Bignoniaeae have complex evolutionary origins that reflect the importance of ecological and environmental influences.

**Conclusion(s)**

This phylogenetic framework provides important insights into contemporary diversity patterns in Bignoniaeae. These analyses suggest that a considerable evolutionary complexity underlies contemporary patterns.

**Keywords:** Phylogenetics, Bignoniaceae, Diversification, Neotropical Flora, Biogeography

**Maikhuri Rakesh Kumar, Rawat Lakhpat Singh****Conservation policy and social conflicts in protected areas of the Himalaya and options for conflicts resolution: A case study from Nanda Devi Biosphere Reserve (World Heritage Site), India**

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Contributed oral session O13, Conservation, conflicts resolution and development

**Introduction and goal of study**

The protected areas network of the Indian Himalaya comprises 6 biosphere reserves, 20 national parks and 71 wildlife sanctuaries occupying 9.2% of the area of the Indian Himalaya. The enforcement of these protected areas has tended to disregard traditional agriculture, animal husbandry, natural resource uses and socio-cultural values of local communities leading to conflicts between local people and

protected area managers. These are major threats to biodiversity conservation in the Himalaya.

The NDBR which covers an area of 5820 sq. km. and was established on 18 January 1988 under UNESCO's Man and Biosphere (MAB) programme is one such reserve where a total population of about 20,000 inhabitants in the buffer zone areas have been deprived of the traditional uses of natural resources from the reserve. Ignoring the dependence of the local people for their subsistence needs has created conflicts between protected area managers and local people. This study aimed to analyse: a) the perceptions of the local communities towards conservation policy and related management interventions, b) the nature and magnitude of policy-people conflicts and c) possible options for conflicts resolution.

### **Materials and methods**

People's perceptions were discerned through participatory discussions covering 419 households distributed in 15 villages in the buffer zone. Quantitative information gathered from people included land and livestock holdings, land use, economic losses due to wildlife and compensation provided by the reserve management, etc.

### **Results and discussion**

The deterioration of the rural economy due to the damage of crop and livestock by wildlife, the reduction in areas available for grazing, and the termination of opportunities of income from wild medicinal plant resources and tourism/expedition in the core zone were key negative impacts of the conservation policy felt by more than 90% of the respondents. The reserve management plan lays more emphasis on the legal protection than on the sustainable livelihood.

**Keywords:** Protected areas, Policy-people conflicts, Community participation, Biodiversity conservation, Himalaya

## **Makonese Fred**

### **Interactions between biodiversity conservation and smallholder communities in Zimbabwe**

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Contributed oral session O13, Conservation, conflicts resolution and development

### **Background**

Biodiversity shares landscapes with humans, a situation that normally creates competition between the two. When the agendas collide between welfare of humans and biodiversity conservation, protecting biodiversity should balance between people's wants and the landscapes that house the biodiversity. The dynamic is affected by circumstances. Many intervention failures in biodiversity conservation have been a result of our inability to recognize the temporal and social benefits and costs for optimal design of reserves.

### **Goal**

To create an integrative framework for linking smallholder communities to national biological resources and to develop markets in order to enhance co-habitation, biodiversity management and conservation.

### **Materials and methods**

A questionnaire survey and key informant interviews were carried out to collect information on interventions and biodiversity use for different socio-cultural purposes including food, traditional medicines, income generation, livestock nutrition, soil health, soil fertility improvement and markets. The data was analysed using SPSS Version 8 to determine factors that affect dynamics between human ecology and biodiversity conservation.

### **Results and discussion**

Biodiversity conservation strategies in Zimbabwe are fragmented and there are no established socio-ecological niches for certain biological resources. There is a strong bias towards the protection of wildlife and national monuments and not the ecology that supports the biodiversity. Religion and cultural beliefs no longer play a significant role in protecting the ecology of most endangered species. In many areas of intervention, there was sustainable exploitation of biological resources and positive interactions between biodiversity and smallholder communities.

### **Conclusion**

The study identified the benefits and the costs from successful strategies generated from past and present interventions that facilitate dealing with constraints to biodiversity conservation.

**Keywords:** Biodiversity, conservation, communities, interactions, Zimbabwe

**Matsuda Hiroyuki**, Yahara Tetsukazu, Fujita Taku

**Quantitative projection of plant species loss for 1697 taxa of Japanese vascular plants and its implication for achieving the 2010 biodiversity target**

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Contributed oral session O19, Biodiversity indicators

While many scientists are alarmed that we are into the opening phase of a mass extinction, their projections have hardly been quantified due to the limited availability of time-series data for threatened organisms, especially for plants. In order to quantify the risk of extinction, the Japanese Red Data Book compilation project monitored changes of population size during the past ten years for 1,697 threatened plant taxa in each of 3,781 map grids of ca.100 km<sup>2</sup>. More than 500 citizen botanists contributed to monitor those taxa from 1994-1995 and from 2003-2004. This massive data set enabled us to carry out the world first quantitative projection of plant species loss at national level with stochastic simulations. As a result, 553 taxa (7.9% of the Japanese vascular flora; including 289 endemic to Japan) were projected to go extinct during the century, if the declining trends over the last decade continue. Our monitoring also suggests a pathway to reduce this rate of loss and so address the 2010 biodiversity target of "significant reduction in the rate of loss of biodiversity". We used systematic conservation planning to identify a set of sites whose protection would imply a reduced rate of extinctions. In countries where citizen botanists can be organized to monitor threatened taxa, censuses using our method should be able to quantify how fast we are losing species and how effectively we can reduce the projected loss by conserving "hotspots" of threats.

**Keywords:** extinction risk, vascular plant, Hotspot in Japan, future projection, 2010 biodiversity target

**Matthee Sonja**, McGeoch Melodie

**The effect of habitat fragmentation on rodent macroparasite communities in the Cape Floristic Region**

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Contributed oral session O5, Drivers of biodiversity 1

Agricultural development is an important cause of losses in plant and animal diversity, driven at least in part by habitat fragmentation. To date few studies, and none in South Africa, have tested if fragmentation has an effect on the diversity and community structure of parasites on vertebrate hosts.

**Materials and Methods**

The striped mouse, *Rhabdomys pumilio*, was live trapped at 6 localities (3 pairs of pristine natural areas and habitat fragments) in the Cape Floristic Region during 2003-2004. Sex, reproductive state and body measurements were recorded for each animal. All ectoparasites were removed, counted and identified to species level. Generalized linear models were used to record if fragmentation had an effect on parasite species richness and abundance. Correspondence analysis was performed to examine the effect of fragmentation on the parasite species composition.

**Results and Discussion**

There was no significant difference in the species richness between natural and fragmented sites for all the parasites together or for the individual tick, mite and flea taxa. Parasite abundance was significantly higher in fragments compared to natural areas for all the parasites together. Considering taxa separately, this pattern was recorded for ticks and also for the 3 most abundant individual tick species and 1 of the most abundant flea species. In contrast, a significantly higher abundance was recorded for fleas in the natural areas compared to fragments. Intraspecific comparisons showed that 2 of the 3 most abundant fleas also displayed this pattern. Parasite species composition differed significantly between the natural and fragmented areas, although only a small proportion of the variance in species composition was attributed to fragmentation.

**Conclusion**

It is evident from this study that ticks are more abundant on rodents in habitat fragments surrounded by agricultural activities. However, the patterns differ between parasite taxa and species.

**Keywords:** Agriculture, Fragmentation, Rodents, Ectoparasites, Parasite burden

**McClain Michael**, Abira Margaret, O’Keeffe Jay, Ombara Doris, Naiman Robert, Subalusky Amanda  
**A river environmental flow regime to support people and ecosystems in the Mara-Serengeti Ecoregion, Kenya/Tanzania**

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Contributed oral session O22, Managing for ecosystem services

The annual migration of millions of wildebeest, zebra, gazelle, and associated predators across the Mara-Serengeti Ecoregion of Kenya and Tanzania is one of Africa’s most iconic natural features and the basis for a thriving international tourism industry. The course of this migration is protected by an interlinked network of parks and reserves, and strict rules control future land development. The main threat to this migration and ecoregion is drought and the potential drying of the Mara River, which is the only significant source of surface water during droughts. The situation is made even more precarious by increasing upstream water abstractions to support agricultural and domestic demands. Working with water management and park authorities from the region, an international team of scientists conducted an assessment of the environmental flow requirements of the Mara River for mainstem reaches within and upstream of the migration pathway. We applied a modified version of the Building Block Methodology that prescribed average monthly flows and occasional floods necessary to maintain the river ecosystem in its current state during both normal and drought years. Flows were prescribed to sustain ecosystem services used by both people and wildlife relying on the river. The results indicate that, during normal rainfall years, the environmental flow requirement ranges from 25% to 50% of the mean annual flow, although most flow available for abstraction is concentrated during a few months of high rainfall. In contrast, during serious drought years the environmental flow accounts for nearly all flow in the river and little water is available for abstraction. Research into the environmental flow requirements of the Mara River is ongoing, but results of this first assessment are already being incorporated into the catchment management strategy setting allocation rules and prescribing best practices for land management and off-channel water storage.

**Keywords:** freshwater, environmental flows, East Africa, ecosystem services, water management

**Mcelwee Pamela**

**Is Authoritarianism Good (and Democracy Bad) for Biodiversity?**

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Contributed oral session O13, Conservation, conflicts resolution and development

**Background and goals of study**

Recently, there has been a heated debate in the conservation community regarding the relative successes of participatory “conservation and development” approaches to preserving biodiversity that were popular in the 1990s and the “fortress conservation” tactics these projects purported to replace. This latter camp argues that projects that have focused more on socio-economic and participatory aspects of conservation have not succeeded in arresting threats to species and landscapes. Some prominent conservationists have even gone so far as to argue that fortress conservation is best carried out in authoritarian states that are not beholden to public opinion, and politically repressive regimes like Burma have been praised for their conservation work. The ability of authoritarian states to declare conservation lands and laws without the public approval processes often necessary in democracies have been pointed to as potential advantages for environmental protection.

**Materials and methods**

This paper will take up the idea of whether or not authoritarian regimes actually achieve more success in biodiversity conservation than democratically elected ones. The paper first presents a meta-analysis of the size and effectiveness of protected areas when measured against political and civil liberties in a range of states. The paper then shows with case studies from the Greater Mekong region how authoritarian and non-democratic regimes actually undermine conservation objectives through many of their actions, including militarism of fragile environments, the susceptibility of such regimes to corruption, and the challenges of decision-making among government branches in one-party states.

**Results and Discussion**

The paper concludes with a look at how more participatory and democratic approaches to conservation in states such as Thailand, Burma and Vietnam would likely result in better biodiversity conservation outcomes.

**Keywords:** conservation policy, protected areas, ICDPs, democratization, decentralization

**Meffert Douglas****Climate change, disasters, and the resilience of New Orleans: Adaptation of ecosystem services in a dynamic urban and coastal landscape**

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Contributed oral session O14, Biodiversity and climate change

Humans continue to populate coastal areas worldwide that are vulnerable to the near and long-term effects of climate change. New Orleans, Louisiana, USA, like many historic deltaic cities, exploited the interface of land and water at a time when waterborne transportation accounted for nearly all long-distance human movement and trade. Modern New Orleans is located on a subsiding deltaic landscape, surrounded by a rapidly eroding coast and rising seas. Louisiana is experiencing up to 80% of the United States wetland loss due to anthropogenic and natural causes, including sea-level rise and hurricanes. This situation is not unlike other deltaic and coastal settlements, and thus offers lessons, experiences, and technologies for human coastal environments worldwide.

This paper focuses on emergent trends and ecosystem “shocks”, including climate change and hurricanes, along with resultant policies and practice that represent ecosystem adaptation, social-ecological learning, adaptive land use, and governance. The role of urban form in adapting to and mitigating global warming while providing for biodiversity and other ecosystem services will be explicitly addressed. A review of current structural and non-structural urban and coastal land use challenges and opportunities, with a special focus on the integrated New Orleans and coastal Louisiana ecosystems, will be of particular value to urban planners and local institutions dealing with climate change at the metropolitan scale.

Land use and policy interventions will include restoration and protective measures for critical landforms, including the urbanized metropolitan area, bays, shorelines, and peninsulas of urbanized and rural areas of the southeast deltaic plain of Louisiana. The approach will address practices that promote sustainable development, including accepted smart growth principles, biodiversity, and the ways in which urban management can support the resilience of cities in the face of climate change.

**Keywords:** climate change, coastal restoration, urban sustainability, ecosystem services, land use

**Messouli Mohammed, El Alami El Filali Asma, Babqiqi Abdelaziz****The sensitivity and vulnerability of aquatic habitats and species in Morocco to climate change**

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Contributed oral session O10, Projecting 21st century biodiversity change

**Background and goal of study**

Anthropogenic climate change over the past 30 years has produced numerous shifts in the distributions and abundances of species. This has important implications for conservation practice and policy. The aim of this study was to model the direct impacts of climate change on aquatic environments in Morocco in order to understand the possible changes in the distribution of species and the composition of habitats.

**Materials and Methods**

A model, based on simple simulation models, was used to generate hypotheses and to test uncertainty with different climate change scenarios. Changes in the bioclimate envelope of species were predicted, under climate change scenarios using the Statistical Down Scaling Model (SDSM) and the atmospheric general circulation model HadCM. A total of 20 species, representing several taxa, were modelled.

**Results and Discussion**

Many species demonstrated a consistent response to climate change, either increasing or losing suitable climate space, although some had a variable response with losses starting to occur under the high scenarios. The percentage change in the bioclimate envelope of the species was calculated. This showed that ephemeral freshwater systems species and habitats were the most sensitive to climate change. Oasis areas or species with Southern distributions were also sensitive to losses, while species gaining suitable climate space represented a variety of habitats. Sensitivity needs to be viewed alongside vulnerability, the ability of the species or habitat to adapt to climate change. Hyporheic milieu, oases and “Wadi” species and habitats were the most vulnerable, with limited adaptation possibilities.

**Conclusion**

Models of this type are important because they incorporate at least some management options, can explore some adaptations, and can deal with a large range of interacting factors such as CO<sub>2</sub> concentration, and soil type.

**Keywords:** Adaptive capacity, North Africa, simulation model, bioclimate envelopes, resilience

**Mewes Melanie, Wätzold Frank, Van Apeldoorn Rob, Varjopuro Riku, Chmielewski Tadeusz Jan**  
**Cost-effectiveness of managing Natura 2000 sites: An exploratory study for Finland, Germany, the Netherlands and Poland**

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Contributed oral session 08, Conservation planning 1

Natura 2000 sites are expected to assure the long-term survival of Europe's most valuable and threatened species and habitats. It follows that successful management of the sites is of great importance. Next to goal attainment, cost-effectiveness is increasingly recognised as a key requirement for gaining social and political acceptance for costly conservation measures. We identify and qualitatively examine issues of cost-effectiveness related to the design and implementation of management measures in Natura 2000 sites in Finland, Germany, the Netherlands and Poland. Given the wide variety of management design and implementation options within the four countries, our study is purely of an exploratory nature. We derive recommendations for improving the cost-effectiveness of management in Natura 2000 sites and for future research. Examples of policy recommendations include guaranteeing the availability of funds for longer periods, and ensuring the appropriate allocation of funds between the different tasks of designing and implementing management plans. Further research should examine the cost-effectiveness of controversial suggestions such as, for example, more tailored payment schemes for conservation measures that result in higher ecological outputs but are costly to administer. Moreover, more research is needed to better understand how rules for administrations, as well as rules and governance structures for tasks within administrations, should be designed.

**Keywords:** cost-effectiveness, exploratory study, Natura 2000, management, conservation

**Mills James**

**Decreasing small mammal diversity and increasing human disease risk: a case study from the hantaviruses**

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Contributed oral session 09, Global environmental change and health

**Background and goal of study**

Although decreasing biodiversity is often cited as a factor in increasing risk of zoonotic disease, there are few scientific studies that provide evidence or mechanisms for such a link. We explored the link between decreasing diversity of a vertebrate host community and increasing incidence of hantavirus transmission among rodents in the Southwestern United States.

**Materials and methods**

We used data from a 12-year longitudinal study of hantavirus host populations at 10 study sites to explore the relationship between small-mammal community characteristics (e.g., richness, diversity, species composition, population densities) and prevalence of infection with hantaviruses in primary rodent host species.

**Results and discussion**

A clear inverse correlation was observed between long-term prevalence of infection in host populations and diversity (Simpson's Index) of the small-mammal community. Correlations were clear when using long-term average values for rodent community diversity and hantavirus infection prevalence but not when using short-term datasets. This inverse relationship was observed in the spatial dimension but not in the temporal dimension.

**Conclusion**

These results suggest that the relationship between diversity and pathogen transmission is an intrinsic site-specific property that is probabilistic in nature. Such relationships may only be demonstrated by using long-term datasets.

**Keywords:** zoonoses, diversity, hantavirus, rodents, disease

**Mnyazi Jefwa Joyce**, Sydney Stumer, Balakishna, Susan Serani, Lucia Varela, Jeroen Huisinng, Peter Okoth, Joseph Munga'tu, Stephen Lchami

**Can arbuscular mycorrhizal fungi (AMF) be indicators of soil quality?**

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Contributed oral session O21, Monitoring biodiversity

Arbuscular mycorrhizal fungi (AMF) were studied in different land use types from seven tropical countries and their potential as soil quality indicators. The potential of AMF genera as a diagnostic tool for soil quality was assessed. Soil properties examined were pH<sub>w</sub>, total carbon (TC), total nitrogen (TN), extractable phosphorus (Ext. P), exchangeable potassium (K), exchangeable calcium (Ca), exchangeable magnesium (Mg), sand, silt, and clay, which were analyzed using standard laboratory methods widely used for tropical soils. Land use types were classified into 16 classes. Multivariate analysis of principle component (PCA) was used to generate general soil quality indicators through a linear combination of chemical and physical properties that gave a holistic representation of the soil quality. AMF species were identified in samples from field and/or trap cultures, belonging to AMF genera; Glomus, Gigaspora, Scutellospora, Acaulospora, and Entrophospora. The identification of AMF was made by observation of spore morphology and confirmed by sequencing. Canonical correspondence analysis indicated that different genera can be associated with soil properties. The general indicators of soil quality developed and used to identify which AMF genera could be a genus indicator of soil quality. Scutellospora was established to be the appropriate genus that mostly acts as an indicator genus of soil quality since its total abundance increased as the general soil fertility score increased from negative to positive. However, the general Mycospora showed an inverse relationship with an increase in the soil fertility score leading to a decreased abundance of Mycospora, which may be attributed to its pathogenic characteristics. This study indicated the potential of soil AMF genera as useful biological indicators of soil quality.

**Keywords:** Soil quality, AMF, Land use, biodiversity, tropical systems

**Morin Xavier**

**Developing process-based models to predict woody species range shifts under global change: state of the art and perspectives**

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Contributed oral session O14, Biodiversity and climate change

Climate change has already caused range shifts in some tree species, and climatic predictions suggest that these shifts could increase as well as impact more species in the future. Pioneering efforts to predict shifts in species distribution under climate change used habitat models based on the correlation between contemporary environmental factors and the distributions at coarse spatial scales. But developing mitigation strategies requires models that can make more robust predictions at both coarse and fine spatiotemporal scales. Process-based models of the distribution of both species and vegetation types have begun to emerge to meet these needs. Using the model PHENOFIT as a basis, we here present potential range shifts of North American boreal and temperate tree species under two scenarios of climate change taking into account colonization of suitable habitats. We then compare these predictions with those made by a habitat model. Finally, we highlight how recent advances in our understanding of relationships among the niche concept, species diversity and community assembly point the way toward down-scaled models predicting the impacts of global change on species distribution and community diversity, under a process-based framework.

**Keywords:** Climate change, process-based modelling, range shifts, trees, biodiversity

**Mota Rui**, Domingos Tiago

**Niche construction, resilience and restoration ecology: Managing regime shifts in semi arid regions**

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Contributed oral session O18, Ecological restoration

Using concepts from ecosystem engineering (or niche construction), complex systems, and restoration ecology we present a model of a semi arid ecosystem that formalizes recent works on how human management and climate/vegetation feedbacks provided conditions for the regime shifts in the Sahara and Sahel deserts. The concept of ecosystem engineering was defined as organisms that control the availability of resources to other organisms by causing physical state changes. According to the literature on complex systems, ecosystems exhibit historical dependency, thresholds, multiple equilibria, and limited predictability. Our focus is on thresholds related to feedbacks between ecological, economic, and climatic systems. In the Sahel desert, it has been demonstrated that a small amount of land degradation could have triggered the regional shift from the wet Sahel regime to the dry Sahel, being amplified by vegetation-atmosphere feedbacks. Regarding restoration, since the rates at which processes occur in ecosystems often differ widely, it is convenient to speak of slow and fast variables. Here the parameter representing carrying capacity in the usual logistic model of ecosystem growth is taken as a constant (slow

variable) and represents the underlying structure of the ecosystem, whereas the ecosystem biomass (fast variable) reveals the dynamics of this underlying structure. We study how slow-variables affect resilience by deriving an ecosystem production function with a variable carrying capacity due to niche construction. We show that niche construction implies the existence of different dynamics (pure compensation, depensation and critical depensation). We also present and analyze the optimal management policies for each type of ecosystem dynamics in a resource management model. Generally, the dynamics of the degraded state are different from the pristine or target state. Thus the trajectory to recovery will generally be different from that of the degradation (hysteresis).

**Keywords:** Niche construction, resilience, optimal management, regime shifts, desertification

**Mugonola Basil, Moses Isabiryeye, Brian Isabiryeye, Charles Nkwiine Mary-Silver Rwakaikara**  
**Farm level economic evaluation of biodiversity enhancing technologies in agricultural production in Mukono District, Uganda**

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 Contributed oral session O3, Agrobiodiversity

**Background and goal of study**

Economic evaluation of management options for conserving and enhancing biological diversity in agricultural production was done. This work was within the framework of the Conservation and Sustainable Management of Belowground Biodiversity project (BGBD), which strives to enhance awareness, knowledge and understanding of BGBD important to sustain agricultural production in tropical land use systems. Integrating conservation in sustainable production systems ensures that agricultural productivity is enhanced, prevents further incursion into natural landscapes, and biodiversity is harnessed and conserved. Economics of on-farm studies help translate technical feasibility into economic feasibility by considering farmers' managerial, farm resource constraints and serves as a decision tool.

**Materials and methods**

Data were obtained from on-farm experiments on Legume Nodulating Bacteria (LNB), Mucuna improved fallows, Maize Stover application and Earthworm inoculation conducted in Mukono district in sub-counties: Nagojje, Sagazi and Kyampisi. Partial budgets and farmer participatory approaches were used to value benefits and costs. The marginal rate of return was calculated to determine which options were dominant relative to farmers' practice, and marginal analysis curves were constructed. Sensitivity analysis enabled to incorporate variability in the analysis.

**Results and discussion, conclusions**

Results indicate that all technologies were superior to the farmers' practice. However, some were dominated because of the high cost outlays involved and/or small net benefits. Sensitivity analysis indicates that the technologies are sensitive to prices and yield variability. Economic viability of sustainable management options that enable farmers to achieve both objectives of increased crop productivity and enhanced conservation of biodiversity in agriculture is important. Availing such a decision support tool is a useful milestone in agro-biological conservation.

**Keywords:** Partial budget, Marginal analysis, Sensitivity analysis, Economic Evaluation, biodiversity

**Natuhara Yoshihiro**

**Restoration of wetland biodiversity in traditional agricultural landscape, Satoyama in Japan**

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 Contributed oral session O18, Ecological restoration

This study aims to investigate the biodiversity in a rice paddy area in Japan and to develop an easy and effective system for biodiversity farming. Satoyama is a rural landscape that has been developed over centuries of agricultural use in Japan. Satoyama contains a mosaic of mixed forests, rice paddy fields, grasslands, streams, ponds, and reservoirs for irrigation. Satoyama is important in its biological and cultural diversity because, (1) Making mosaic landscapes. "Yatsuda" paddies in the hill valley and the agricultural forest on the top of the hill provide mosaic landscapes and these mosaics provide habitats for many amphibians, raptors and grassland flowers. (2) Paddies provide spawning and nursery for fish by connecting rivers in the rainy season.

While the rice paddy area is the habitat for many endangered species it is not protected as a nature reserve. In order to conserve the biodiversity of the paddy field in the area, farmers and consumers should be aware of the value of biodiversity in the paddy and use it in a sustainable way. Biodiversity farming increases ecosystems services on a regional basis, such as added value of pesticide-free products, fish products in the irrigation system, and more predatory insects.

In this study, (1) biodiversity, environmental and social data were collected and analyzed, using a geographic information system to develop a method to find the local characteristics of biodiversity. (2) We also made experiments to develop easy and effective measures to increase biodiversity in the paddy fields. (3) We investigated agricultural communities to clarify the economic conditions and social capital that support decision making for biodiversity farming in a sustainable way. The conservation of biodiversity in agriculture is an important part of the 2010 targets and to set new goals of biodiversity conservation from COP10 onward. Community based decision-making mechanisms that have supported the traditional society in Japan, are expected to contribute significantly to biodiversity conservation on a global scale.

**Keywords:** agriculture, biodiversity, flood plain, landscape, social capital

## Nogues-Bravo David

### **Hindcasting species climatic niches**

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Contributed oral session O14, Biodiversity and climate change

#### **Background**

Predicting past distributions of the climatic niches of species, hindcasting, by using climate envelope models is emerging as an exciting research area. Climate envelope models, CEMs, are used to examine veiled evolutionary questions about extinctions, locations of past refugia, migration pathways, or to propose hypotheses concerning the past population structure of species in phylogeographical studies. They might be a key approach to enhance our knowledge about extinction crises when factors such as humans and climatic change come together in past periods (i.e., Late Quaternary) and in the coming future.

#### **Goal**

Here, I review the literature on hindcasting CEMs. I discuss the theoretical assumptions behind niche modelling, stability of climatic niches through time and the equilibrium of species with climate. I also summarise a set of "recommended practices" to improve hindcasting.

#### **Results**

The studies reviewed 1) rarely test the theoretical assumptions behind niche modelling such as the stability of species' climatic niches through time and the equilibrium of species with climate, 2) they only use one model class (72% of the studies) and one paleoclimatic reconstruction (62.5%) to calibrate their models, 3) they do not check for the occurrence of non-analogous climates (97%), and 4) they do not use independent data to validate the models (72%).

#### **Conclusion**

Ignoring the theoretical assumptions behind niche modelling and using inadequate methods for hindcasting CEMs may well entail a cascade of errors and naïve ecological and evolutionary inferences. We also should push integrative research lines linking Macroecology, Physiology, Population Biology, Paleontology, Evolutionary Biology and CEMs for a better understanding of niche dynamics across space and time.

**Keywords:** climate envelope models, climate change, niche dynamics, fossil record, physiological limits

## Norberg Jon

### **A trait-based framework for linking global change to ecosystem services: implications for management**

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Contributed oral session O7, Biodiversity and ecosystem functioning 1

#### **Background**

The trait-based framework focuses on what species do, and how they respond, rather than on their taxonomic identity. There are different kinds of traits that determine the species contribution to ecosystem processes, their response to the environment and the way populations sustain themselves over space and time. I will review the conceptual frameworks used today, which try to link these classes of traits in relation to the management of ecosystem services in the face of global change, and show modelling results that link species sorting and evolutionary processes in response to climate change into a single framework.

**Material and methods**

I present a conceptual framework that links environmental change, ecosystem services and population persistence in space and time. Also, I present a numerical spatially explicit approach to study community level responses to climate change and separating the response into components relating to evolution, species sorting and dispersal.

**Result and discussion**

Species differ in many traits, such as how they respond to environmental drivers, how they contribute to other ecosystem processes, or how they disperse through space and time. Correlations among the distributions of these traits have implications on the question how environmental changes and management practices affect the maintenance of ecosystem services. Also, understanding the correlations between the distributions of different traits can provide an understanding of the trade-off between different ecosystem services.

**Conclusion**

- 1) A trait-based framework is highly suited for understanding climate change impact scenarios as well as for guiding management policies.
- 2) Evolutionary and species sorting processes interact in determining the community response to climate change. Particularly at the leading and trailing edges of communities subjected to climate change, changes in the relative importance between different processes of change become apparent.

**Keywords:** trait-based, climate change, ecosystem services, evolution, species sorting

**Norström Albert**, Nyström Magnus, Obura David

**Trait diversity in western Indian Ocean coral reef assemblages: assessing functional redundancy and response diversity**

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Contributed oral session 07, Biodiversity and ecosystem functioning 1

**Background and goal of study**

Coral reef resilience has been suggested to be conferred by the diversity of species' functional and response traits, rather than by the number of species per se. Information on species' traits allows the classification of different functional groups and provides a way to discern how species' diversity may interact with important ecosystem processes that underpin coral reef resilience. However, empirical assessments of functional and response diversity exist for coral assemblages, and have been restricted to i) simple functional group classifications solely based on coral morphological traits and ii) small spatial scales. Understanding how these components of coral biodiversity behave across a wide regional context and under different management regimes is vital. The aim of this study is to i) classify the coral functional and response diversity in 25 reef assemblages in the western Indian Ocean and ii) correlate the distribution of functional and response traits to the latitudinal gradient and the reef accessibility (protective status of reef, proximity to shore).

**Material and methods**

A database was created, through literature surveys and field data, on a range of functional and response traits of scleractinian corals. Trait information was applied to a regional, species-level data set of scleractinian corals from 25 reefs in the Western Indian Ocean. Functional diversity was assessed through measures of functional distinctness and its relationship to changes in the latitude and the reef accessibility analysed through linear regression analysis.

**Results/conclusions**

Preliminary results suggest that the distribution and abundance of functional traits varies with respect to reef accessibility, i.e. the functional diversity is less on reefs close to the shore and open to fisheries. These accessible reefs also exhibit lower abundances of key ecosystem traits in corals (related to habitat function and connectivity).

**Keywords:** coral reefs, traits, resilience, functional groups, response diversity

**O’Gorman Eoin**, Emmerson Mark**Perturbations to trophic interactions and the stability of complex food webs**

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Contributed oral session O11, Biodiversity and ecosystem functioning 2

**Background and goal of study**

The pattern of predator-prey interactions is thought to be a key determinant of ecosystem processes and stability. Complex ecological networks are characterised by distributions of interaction strengths that are highly skewed, with many weak and few strong interactors present. Theory suggests that this pattern promotes stability as weak interactors dampen the destabilising potential of strong interactors.

**Materials and methods**

We present an experimental test of this hypothesis and provide empirical evidence that the loss of weak interactors can destabilise communities in nature. We ranked ten marine consumer species by the strength of their trophic interactions. We removed the strongest and weakest of these interactors from experimental food webs containing more than 100 species.

**Results and discussion**

The extinction of strong interactors produced a dramatic trophic cascade and reduced the temporal stability of key ecosystem process rates, community diversity and resistance to changes in community composition. The loss of weak interactors also proved damaging for the integrity of our experimental ecosystems, leading to reductions in the temporal and spatial stability of ecosystem process rates, community diversity and resistance.

**Conclusion**

These results highlight the importance of conserving species to maintain the stabilising pattern of trophic interactions in nature, even if they are perceived to have weak effects in the system.

**Keywords:** interaction strength, dynamic index, predator-prey interactions, biodiversity and ecosystem functioning, temporal and spatial variability

**Ogada Mordecai****Competition between Nile perch, otters and fishermen in the littoral zone of Lake Victoria: An impending disaster?**

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Contributed oral session O5, Drivers of biodiversity 1

**Background and goals**

The effects of the Nile perch (*Lates niloticus*) on the cichlids of Lake Victoria is well-documented, though its impacts on other piscivorous fauna and human fish consumers are less known. The spot-necked otter (*Lutra maculicollis*) is a key predator in the inshore and littoral zones, where the aquatic communities are dominated by *cichlidae*, mainly *Oreochromis niloticus* and numerous species of *Haplochromis*. This zone is also the mainstay of subsistence fishermen, i.e. those who cannot access deep-water fisheries due to their inability to afford fishing boats or larger fishing nets. We wanted to find out which of the 3 consumers is most affected by the competition and how.

**Materials and methods**

We investigated the otter diet by an analysis of fish remains in scats, and the Nile perch diet by an analysis of stomach contents of measured adult specimens from fish processors. Bones were used to identify prey items and estimate their numbers in both the perch and the otter diet. We also randomly sampled the fish catch from landing beaches in our study area (Kisumu, Kenya).

**Results and discussion**

We found that adult perch and otters compete for the same size-class of fish (8-10cm) in deeper water. This has led to increased direct competition between otters and fishermen for fish resources in the inshore and littoral zones. This competition is revealed in the declining fish catch (Perch; 6.5% per annum, Tilapia 10% per annum), and the rising market price for fish (Perch 55% per annum, Tilapia 50% per annum) over the last 6 years. It is also illustrated by the increase in ‘net-raiding’ by otters and the rising percentage of crab (*Potamonautes niloticus*) in the otters’ diet.

### Conclusion

Lake Victoria (Kenya) fisheries are being overexploited with serious ecological and socio-economic effects on the ecosystem and local people respectively. The decline of Nile perch will be disastrous in the short term but beneficial to the ecosystem and people in the long term.

**Keywords:** Perch, Otters, Victoria, Fisheries, Competition

**Okoth Peter**, Jeroen Huising, Joseph Mung'atu, and Stephen Lchami

### **Distribution of soil organisms in diverse tropical ecosystems: The impact of land use on abundance, richness and diversity**

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Contributed oral session O12, Drivers of biodiversity 2

It is argued that soil organisms and their individual functions provide an important resource for the sustainable management of agricultural productivity in addition to other ecosystem services. We investigated four macro-fauna groups i.e., ants (Hymenoptera: Formicidae); beetles (Coleoptera); earthworm communities; termite communities (Isoptera); and one fungal group (arbuscular mycorrhizal fungi) across land use intensity gradients in selected benchmark areas in Brazil, Cote d'Ivoire, India, Indonesia, Kenya, Mexico, and Uganda. Sampling was carried out within 'sampling windows' in each benchmark area to capture occurring land use kinds and systems.

Earthworms were collected from the field using monoliths at the end of the rainy season where earthworms are known to be more active. Termites, ants and beetles were studied using soil monoliths measuring 25 x 25 x 30 cm. A modified ALL (Ant leaf litters) protocol based on a Winkler and Pitfall trap collecting method was used to collect ants. Beetles were extracted from litter using the Winkler. Arbuscular mycorrhizal fungi (AMF) were extracted from 12 points using augers around two concentric rings measuring 3 and 6 meter radius. Soil core samples were taken up the depth of 20 cm using a soil corer of 5 cm diameter and 20 cm long. Eight different points within the 6m radius and 4 points in the 3 m radius were cored and the soil bulked together.

Statistical analyses were used to evaluate the influence of land use intensity and the geographic location of benchmark sites on the biodiversity of the soil fauna. The analyses were based on biological diversity indicators; i.e., species abundance, species richness, and species diversity using the Shannon-Wiener Index and the evenness of the species distribution across land use kinds.

The highest richness was encountered in agroforestry systems where the arbuscular mycorrhizal fungi (AMF) recorded 17 species.

**Keywords:** Biota, Diversity, Richness, Land Use, Tropical ecosystems

**Olschewski Roland**, Klein Alexandra Maria, Tschardtke Teja

### **Assessing trade-offs between ecosystem services**

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Contributed oral session O20, Economics of biodiversity 2

### Background

We focus on three ecosystem services, namely the provision of timber, the regulation of atmospheric carbon dioxide, and the supporting service of bee pollination for coffee production. Analysing possible trade-offs, we answer the questions, under which circumstances particular services are economically attractive and how an efficient joint production of multiple ecosystem services can be achieved.

### Material and methods

The study was conducted in a highly fragmented area in North-Western Ecuador. Data on timber production and carbon sequestration are based on a growth model for *Cordia alliodora*. Economic information was gathered through field surveys and official public statistics. Carbon revenues are calculated based on current CDM accounting procedures. Pollination services are assessed by focusing on the impact of pollinators on berry weight and determining pollination values at harvest. We use scenario techniques to determine the ecological and economic impact of alternative silvicultural management regimes.

### Results

We show a trade-off between the different ecosystem services. A subsequent reduction of tree density leads to a more open canopy cover, thereby allowing for a higher diversity and density of flowering plants in the under storey layer and an improvement of ground-nesting and

floral resources for bees, and consequently, bee abundance and diversity increases. The trade-off consists of enhancing pollination services by increased pollinator availability, which comes at the cost of reduced timber and carbon revenues.

### Conclusion

Our study shows that considering several ecosystem services simultaneously can have a substantial impact on the recommendations for management decisions in a multifunctional landscape. The crucial condition for the economic attractiveness of a bee-friendly management is that forest owners are rewarded for the services they provide.

**Keywords:** crop pollination, carbon sequestration, timber production, valuation, biodiversity

## **Oteros-Rozas Elisa, Casas-Nogales Raquel, González José A., Martín-López Berta** **Characterizing ecosystem functions and services generated by transhumance in a Mediterranean landscape**

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Contributed oral session O22, Managing for ecosystem services

### Background

The Mediterranean basin is one of the world's most important biodiversity hotspots, where human civilization and wild nature have coexisted for centuries. The existence of seasonal changes in pasture availability has historically encouraged transhumance, a practice that involves the seasonal migration of livestock. However, a progressive abandonment of this practice is taking place as a result of socio-cultural and economic drivers. We used a social-ecological approach to characterize ecosystem functions and services generated and/or maintained by transhumant movements along the only drove road (ca. 500 km) still in use in Spain.

### Methods

Semi-structured interviews and participatory workshops with shepherds, managers, and decision-makers were carried out, along with a literature review, in order to identify ecosystem functions and services as well as beneficiaries at different spatial scales.

### Results and discussion

Although the perceptions of stakeholders differed, our results reveal the importance of transhumance for maintaining several regulating functions and services such as the maintenance of biological and genetic diversity, ecological connectivity, climate regulation, soil retention and formation, and fire prevention. Some important cultural services (traditional ecological knowledge, recreation) were also recognized, along with the better-known provisioning services (food, wool). The global significance and the future of transhumance in the face of global change is discussed, and new insights are provided in order to contribute to the ongoing debate on economic incentives for rural development and the reform of the Common Agricultural Policy of the European Union.

### Conclusion

The progressive abandonment of traditional customary practices like transhumance in Mediterranean landscapes is having severe negative effects on the maintenance of some critical ecosystem functions and services, essential for biodiversity conservation and human wellbeing.

**Keywords:** transhumance, ecosystem services, agrobiodiversity, Mediterranean basin, environmental policy

## **Oyono Phil René, Tchikangwa Bertin, Ribot Jesse, White Andy**

### **Forest tenure, community rights and conservation strategies in francophone Africa: Key issues and new challenges**

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Contributed oral session O4, Managing biodiversity with a social-ecological system focus

Forest tenure in francophone Africa is dominated by public or state ownership. The formation of state ownership rights to forests is a long process the cornerstone of which is the growing marginalization of the local communities from ownership and access. The multiplication of protected areas, notably national parks, and conservation landscapes, conservation despotism and the conflict of discourses over forests are meaningful for this tragedy of contested access. Based on an analysis of both colonial and post-independence forest tenure systems, the decoding of various discourses and participatory tools of community research conducted in Central and West Africa, this paper aims at exploring the relationships between public forest tenure and conservation theory and practices across time and their effects on community rights, citizenship, the formation of livelihoods and environmental justice. The paper also addresses the issue of conservationism and despotic conservation as they relate to global paradigms such as environmental governance, climate change, and human rights. As a

result, there is a theoretical and policy dilemma summarized in the following interrogations: how can pro-state forest tenure systems and conservation, on the one hand, and community rights to nature and decentralization, on the other, cohabit? What is the future scenario of the linear cohabitation of such antithetic categories? As a contribution to dilemma solving, the authors propose the following policy options: [a] the partial but substantive deconstruction of pro-state forest tenure systems and public ownership; [b] the decentralization of conservation; [c] payment for historical and social community conservation efforts.

**Keywords:** Tenure, ownership, local communities, conservationism, environmental justice

## **Paumgarten Fiona**

### **What do Poverty Reduction Strategy Papers mean for biodiversity and rural livelihoods in Zambia, Malawi and Tanzania?**

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Contributed oral session O16, Biodiversity governance

#### **Background**

Poverty Reduction Strategy Papers (PRSPs) are a requirement for concessional assistance from the World Bank and IMF and the provision of debt relief under the Highly Indebted Poor Countries (HIPC) initiative. PRSPs describe a country's macroeconomic, structural and social policies and programs aimed at promoting growth and poverty reduction. PRSPs have been criticized for failing to mainstream biodiversity and to recognize environmental goods and services and their contribution to rural livelihoods. This has direct implications as government and donor funds are channeled to other sectors. This paper analyses the extent to which forests are mainstreamed in the PRSPs of Zambia, Malawi and Tanzania and the implications of this on budget allocations and the forest sectors in general. Recommendations are made on mechanisms to mainstream forests in future PRSPs.

#### **Methods**

This work involved a literature review, budget analyses, a review of PRSP content (in terms of programs and policies) and key informant interviews.

#### **Results, discussion**

Despite their contribution to rural livelihoods, forests have a low profile in government and civil society. This is reflected in the content of PRSPs, in declining budget allocations and in a minor total budget share compared to other sectors. Declining budget allocations have implications for the future of forests and the livelihoods of those who rely on the goods and services provided. Furthermore forest sectors are weakened in terms of capacity and therefore less able to show their relevance.

#### **Conclusion**

The failure of PRSPs to mainstream biodiversity, including forests, has considerable implications for biodiversity conservation in Africa's dry forests. Stakeholders interested in biodiversity conservation and the livelihoods of rural households need to engage more actively at the science-policy interface and in the formulation of future PRSPs to ensure a greater share of budget allocations.

**Keywords:** PRSP, policy, biodiversity, livelihoods, Africa

## **Pereira Henrique Miguel, Proença Vânia**

### **Scenarios for Biodiversity Change in the 21st Century**

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Contributed oral session O10, Projecting 21st century biodiversity change

The Millennium Ecosystem Assessment and other recent studies have developed scenarios for the future of global terrestrial, freshwater and marine biodiversity. Here we revise the main results of these scenarios and their implications for ecosystem services and human well-being. Terrestrial biodiversity will continue to be lost due to land-use change, and unless human population growth and consumption patterns are minimized, we may lose more than 20% of plant species by the end of the century. Freshwater systems are perhaps where biodiversity has been more threatened, mainly due to invasives, pollution and habitat fragmentation by dam construction. Climate change over this century and water withdrawal will further exacerbate the effects of these drivers. Marine biodiversity has been declining due to over fishing and unless better fisheries management is implemented worldwide, the growing demand for fish will bring many marine fisheries to collapse by 2050.

**Keywords:** Biodiversity, Species-area, Scenario, Countryside, Extinctions

**Pugnaire Francisco I.**, Armas Cristina, Padilla Francisco M., Jackson Robert B.

**Physiological mechanisms of competitive exclusion in a coastal sand dune system**

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Contributed oral session 07, Biodiversity and ecosystem functioning 1

The different abilities of plants to use ephemeral or permanent water sources strongly influence physiological performance and species coexistence in water-limited ecosystems such as sand dune systems where, in addition, plants have to endure high salinity which contributes to exacerbate environmental harshness. Access to water and resistance to salinity are therefore key elements that combine to affect plant performance. We tested whether carbon fixation and water relations of two interacting shrub species was related to root architecture or salinity tolerance. Water sources and interaction outcomes between *Juniperus phoenicea* and *Pistacia lentiscus* were assessed through physiological performance and analyses using the isotopic signature of water. *Juniperus* used only freshwater stored in sand while *Pistacia* was able to take up both freshwater and salty water from the water table. As drought progressed soil layers dried out and *Juniperus* nearly stopped its physiological activity while *Pistacia* remained unaffected. However, when *Juniperus* and *Pistacia* grew together, sap osmolality and water isotopic composition were similar in both species and very different from isolated *Juniperus* suggesting that *Pistacia*, a species that performs hydraulic lift, was supplying water to neighboring *Junipers*. Lifted water, however, did not benefit *Junipers* as physiological performance of individuals co-occurring with *Pistacia* was poor, showing lower water potentials and gas exchange rates than isolated individuals. *Juniperus* is more salt-sensitive than *Pistacia* and cannot stand salty water so that it is dependent on rainfall while *Pistacia*, by accessing the salty water table, is not. The different capacities of the two species to access and use salty water mediated the outcome of their interaction, resulting in asymmetric competition where *Juniper* was negatively affected by *lentisc*. This process provides a mechanistic explanation to competitive displacement of *juniper* by *lentisc*.

**Keywords:** arid environments, competition, facilitation, species coexistence, stable isotopes

**Rajmis Sandra**

**Economic valuation of ecosystem services in middle-east German grassland ecosystems**

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Contributed oral session 01, Economics of biodiversity 1

We investigate willingness-to-pay (WTP) of local residents in two natural reserves in the middle-east of Germany (Thuringian Shale Mountains and Franconian Forest) for different scenarios of changing ecosystem services in grasslands. Even lay persons employ ethical principles and values to justify their actions (Strack et al. 2008). We investigate if WTP for changing ecosystem services of German grassland ecosystems are influenced by ethical principles (utilitarianism, deontology, partiality, hedonism and intuitionism) and personal values (Schwartz 1992). Results provide an important basis for early planning stages of environmental policy e.g. cost-benefit considerations to design grassland conservation programs (e.g. to support extensive farming systems). Based on a stated preference method (Choice Experiment; non-market valuation), we investigate willingness-to-pay (WTP) of local residents for different scenarios of changing ecosystem services in German grasslands. Pilot study results for ecosystem services of German grasslands range between 10.10 €/year and person and 48.23 €/year and person. Nested Logit analysis identified an annual WTP of 48.23 €/year ( $p < 0.001$ ) for the provision of fresh water and water regulation, 11.19 €/year ( $p < 0.05$ ) for aesthetic and recreational services, 36.07 €/year ( $p < 0.001$ ) for conservation of traditional breeds of livestock linked with extensive farming systems, 10.10 €/year ( $p < 0.05$ ) for grassland measures improving general insurance services of grasslands. In the scale of the project region (Thuringian Shale Mountains and Franconian Forest), WTP for an ideal scenario of ecosystem services is about 105.59 €/year and person. Although afflicted with uncertainties a conservative extension to the scale of the German population allows for an estimation of benefits of about 4 billion €/year and household.

**Keywords:** Economic valuation, stated preferences, ecosystem services, ethical principles, personal values

**Ressurreicao Adriana,** Edwards-Jones Gareth, Atkins Jonathan, Burdon Daryl, Austen Melanie, Zarzycki Tomasz

**An economic valuation of marine biodiversity: a multi-case contingent study**

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Contributed oral session 01, Economics of biodiversity 1

Economic studies exploring the value of marine systems are far less common than those on terrestrial systems. This difference is puzzling as there is no a priori reason to suspect that marine systems are less in need of valuation or in any way less valuable. Moreover, economic valuations based on benefits people place on marine biodiversity provide useful information that can be integrated into the decision-mak-

ing process, promoting sustainable management of systems whose integrity is highly threatened. Here, we report the results of a contingent study undertaken at four case-study sites spread across three European countries: Azores islands (Portugal), Gulf of Gdansk (Poland), Isles of Scillies and Flamborough Head (UK). The study considered the value of species richness of five specific marine taxa (mammals, fish, algae, birds and invertebrates), and all marine taxa, as proxies of marine biodiversity. Respondents were asked to value the prevention of either a 10% or 25% decrease from the current level. Results, based on 1732 face-to-face interviews, indicated that across all studies there was a greater willingness to pay for all marine taxa compared with any individual marine taxon group. Small differences occurred in the willingness to pay among different taxa (mammals and fish were valued more highly than birds, invertebrates and algae), and although these differences were significant, they were much lower than a priori expectations. These results throw doubts on the commonly held premise that charismatic/utilitarian taxa have a disproportionately strong influence on the willingness to pay and provide further insights into human preferences for biodiversity conservation.

**Keywords:** Marine, Biodiversity, Multi-case, Contingent, Study

**Reu Björn**, Adams Jonathan, Bohn Kristin, Pavlick Ryan, Kleidon Axel

**Understanding plant functional diversity from ecophysiological trade-offs using the Jena Diversity Model (JeDi)**

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Contributed oral session 07, Biodiversity and ecosystem functioning 1

### Background and Goal of Study

One of the fundamental aspects of vegetation is that it is inherently diverse, in terms of its form and functioning. Geographic distributions of plant biodiversity are the increase of plant species richness towards the tropics, a more even distribution of the relative abundance of plant species in the tropics, and a nearly log-normal relative abundance distribution. Although these large-scale patterns seem closely linked to climate, the underlying mechanisms are poorly understood.

### Materials and Methods

Here we use an individual-based plant diversity model that simulates the life cycle of numerous hypothetical functional species that cover the whole trait space. Climate constraints acting upon ecophysiological trade-offs 'filter' for feasible trait combinations that result into reproductive plant growth strategies.

### Results and Discussion

The simulated geographic variations of richness, evenness and abundance are in good agreement with observations. Our model predicts that in increasingly harsh environments, the range of feasible trait combinations is reduced, thus resulting in lower functional species richness. The reduction of evenness is attributed to a more rapid decline in productivity from the most productive to less productive plant growth strategies since the particular trait setup of the strategy becomes more important in maintaining high productivity in harsher environments. This approach is also able to reproduce the increase in the deviation from a log-normal distribution towards more evenly distributed communities of the tropics.

### Conclusion

Our results suggest that these general biodiversity relationships can be understood primarily by considering the climatic constraints on plant ecophysiological trade-offs. These in turn potentially allow for a mechanistic understanding of plant biodiversity on ecosystem functioning.

**Keywords:** biodiversity, climate, ecophysiology, relative abundance distributions, neutral theory

**Roux Dirk**, Biggs Harry, Hill Liesl, Murray Kevin

**From scorecard to reflective assessment: A new approach to promoting multi-agency cooperation for effective freshwater conservation**

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Contributed oral session 016, Biodiversity governance

### Background and goal

South Africa has enabling frameworks for managing and conserving freshwater biodiversity, including cross-sector policy objectives.

The latter require effective cooperation between multiple (usually overstretched) agencies, each with their own roles and responsibilities.

Coordination across overlapping and sometimes mismatching mandates is often poor. Given diverse expectations and mental models, ecosystem management should probably not target an optimal solution for “the problem”. Instead, it should involve ongoing learning and negotiation in which a high priority is given to participative sense-making and adaptation. Based on this, a scorecard was developed to facilitate multi-agency reflection, mutual learning and cooperative action.

### Methods

Working in consultation with stakeholder agencies, our reflective assessment tool evolved from a typical scorecard. The indicators explicitly address cooperation and co-learning as enabling conditions for effective management in multi-use landscapes. It is designed for joint reflection by multiple agencies, allows for contextual adaptation over time and space, complements adaptive management, and helps with coherent and compelling messaging to various targets. It was piloted with a cluster of implementation agencies with shared responsibility for the management and conservation of freshwater ecosystems.

### Results and Discussion

Participating agencies agreed cooperation is essential but not easy to achieve – it has costs, and benefits are not explicit and immediate. External facilitation may be necessary initially. The assessment tool promotes face-to-face contact and helps structure co-reflection, which stakeholders felt was beneficial and should take place regularly. The tool identifies joint priorities to tackle; enables pooling of scarce resources; and improves collective effectiveness. It places people and trust between them first, positing that effective freshwater conservation will follow.

**Keywords:** freshwater conservation, cooperation, social learning, adaptive management, trust

### Ruwanza Sheunesu, Musil Charles, Esler Karen

#### **Soil nitrogen and phosphorus depletion as a means of restoring degraded lowland fynbos ecosystems invaded by alien grasses**

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Contributed oral session O7, Biodiversity and ecosystem functioning 1

Much of South African lowland fynbos vegetation has been transformed by agriculture and invasive alien grasses. The artificial reduction of plant available N and P in soils, through the addition of carbon and calcium respectively, may provide a means of retarding the growth of alien grasses stimulated by soil nutrient enrichment. These additions may increase the competitive advantage of native species. This premise was tested in both field- and greenhouse-based trials by applying systemic and contact herbicides to reduce the alien invasive grass biomass followed by the addition of C as sucrose and Ca as gypsum to reduce plant available N and P respectively. Sucrose additions caused a significant decline in the quantum yield of photochemistry and a reduction in biomass of both alien and indigenous species. These effects were less prominent where herbicides were applied. Also, the hypothesis that sucrose addition inhibits plant growth by stimulating soil microbial biomass was tested. Two native species were cultivated in heat sterilized and non-sterilized soils in a greenhouse under four different levels of sucrose. Reductions in quantum yield of photochemistry and plant biomass were greater in non-sterilized than sterilized soils and exacerbated by increased levels of sucrose but not correlated with any significant increases in bacterial and coliform cell numbers in response to increased levels of sucrose supplied. These findings pointed to an abiotic mechanism of sucrose inhibition of plant photosynthesis and growth and conclude that the suitability of adding sucrose to restore alien grass invaded abandoned fields is dubious.

**Keywords:** Sucrose addition, Restoration, Microbial immobilization, Abandoned agricultural lands, Soil sterilization

### Ryzhkova Vera, Korets Michael, Danilova Irina

#### **GIS-Based Monitoring of Forest Ecosystem Dynamics and Biodiversity**

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Contributed oral session O21, Monitoring biodiversity

### **Background and Goal of Study**

Forest ecosystem diversity results from consecutive forest succession stages. Our study addressed inventory and classification of the existing diversity of forest communities with an account of site conditions and forest regeneration dynamics, mapping of vegetation cover, estimation and monitoring of the current state, trends, and rates of forest succession for a range of site conditions.

### Materials and Methods

The study covered central Siberian taiga forest ecosystems. Vegetation communities were classified as regeneration series based not on changing external characteristics (species composition), but on similarity of site conditions, genesis, and succession trends. GIS technologies were applied to create an ecological database and vegetation dynamics maps.

### Results and Discussion

GIS subsystem "Forest Dynamics and Biodiversity" was developed within the Forests of Central Siberia (FCS) GIS built at Sukachev Institute of Forest. The core of the subsystem is an ecological database (ED) containing information on forest community species composition and regeneration dynamics, soils, topography, and satellite data. This information is continuously updated using interdisciplinary field study results, archived and literature data. An algorithm of building computer vegetation dynamics maps based on Landsat ETM+ image analysis, a digital relief model, and ground observation data was developed and tested in the field. The vegetation dynamics maps show the distribution of vegetation regeneration series and stages, and, as a part of the GIS database, allow to estimate forest ecosystem diversity in different ecological conditions. Regeneration stages and series reflect ecosystem diversity resulting from both natural and human influences.

### Conclusions

Our approach enables monitoring forest ecosystem dynamics and diversity. The ecological database can be used for estimating forest diversity regarding: (1) species diversity of separate forest communities representing succession stages and (2) landscape-scale forest ecosystem diversity. The maps incorporated in the GIS database reflect forest regeneration dynamics in time and space. Our results are useful for developing sustainable forest management principles, monitoring forest cover and improving methods of forest inventory and mapping.

**Keywords:** ecosystem diversity, regeneration succession, vegetation dynamics map, ecological database, GIS

## **Sabellek Katharina, Da Sylvestre, Landmann Tobias, Sommer Jan Henning, Barthlott Wilhelm** **Integrating potential plant distribution and land cover change: qualifying and monitoring actual habitats of forest species in West Africa**

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Contributed oral session O21, Monitoring biodiversity

### Background/Goal

The aim of our study was to develop a method to identify and monitor habitat quality of forest species by integrating land cover change and modelled distribution areas based on species localities and environmental variables. Hence, this new approach is a fundamental improvement of classical distribution modelling approaches that describe potential distribution ranges without the integration of actual habitat quality.

### Materials/Methods

The focus area is the Volta river basin in West Africa. Species localities and environmental variables at a spatial resolution of 0.1 degrees were used to model potential distribution areas applying the Maxent approach. Our study concentrates on exemplary and representative species of West African forests. We used high resolution Landsat and MODIS time series observation data to map land cover changes between 1990 and 2000. The frequency of forest cover per 0.1 degree grid cell was calculated and used as a measure of habitat quality. By superimposing and weighting modelled potential areas of forest species and the frequency of forest cover, information on actual habitat quality of respective species was derived.

### Results/Discussion

We present maps of actual habitat quality for representative forest species at a spatial resolution of 0.1 degrees modified by land cover data. Between 1990 and 2000 the area of suitable habitats for the selected species predominantly decreased due to human-induced land cover changes. Conversion of forests appears to be related to an increasing population density and demand of pasture and cropland. However, within protected areas, these changes occur in a much lower extent and even show an opposite direction.

### Conclusions

Combining potential distribution and land cover data enables the integration of habitat quality information to species distribution modelling. Time series data allow continuous and repeatable monitoring of changes and is easily applicable to any type of distribution data.

**Keywords:** Plant Distribution Modelling, Land Cover Change, Habitat Quality, Forest, West Africa

**Saizaki Renata, Wünscher Tobias****Designing conservation auctions in developing countries: insights from field experiments in Kakamega, Kenya**

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Contributed oral session O1, Economics of biodiversity 1

**Background and goal of study**

Payments for ecosystem services (PES) is an increasingly used instrument both for financing and implementing ecosystem conservation. PES could help to implement conservation measures such as corridors and buffer zones for Kakamega Forest Protected Area in Kenya. However, because landholders' specific costs are not known to the conservation agency, procurement auctions have been conducted (in developed countries e.g. US and Australia) and shown to be effective instruments to reveal these costs. The main goal of this study is to experimentally investigate the effectiveness of different auction designs: the price rule defining how auction winners are paid (whether uniform or discriminative prices) and if communication and learning effect over time affect the effectiveness of the auction.

**Material and methods**

Because more complex auction design may become analytically intractable, more complicated settings have been tested using experiments with human subjects (economic experiments) or artificial intelligence (agent based models). In this study, economic experiments are used to investigate the bidding behaviour of landholders around Kakamega Forest. In these experiments, PES auctions are simulated where landholders participating in the experiments are the buyers and the experimenters, the sellers. Four treatments were designed to allow the test of price rule and communication separately in repetitive auctions with 10 periods. In total, sixteen experiments were conducted in four villages.

**Results and discussion**

Results show that the discriminative price rule is more cost effective than the uniform price, however the effect of communication was not found to be significant. Further tests are being conducted to investigate learning effects over time.

**Conclusion**

Results of this study give insights to the cost-effective implementation of PES via conservation auctions, contributing to conservation policy in developing countries.

**Keywords:** Conservation auctions, Payments for ecosystem services, cost-effectiveness, economic experiments, Kenya

**Sato Hisashi****Simulation of the vegetation structure and function in a Malaysian tropical rain forest using the individual-based dynamic vegetation model SEIB-DGVM**

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Contributed oral session O14, Biodiversity and climate change

An individual-based Dynamic Global Vegetation Model, the SEIB-DGVM, was adapted to a Malaysian tropical rain forest by incorporating formulas and parameters from a gap dynamics model, FORMIX3. After calibration, the model reconstructed forest structure (i.e., size structure, leaf area index, and woody biomass) and carbon fluxes (i.e., gross and net primary productivity) of a dipterocarp forest in Pasoh, Peninsular Malaysia. Sensitivity analysis demonstrated that the model was robust; forest structure and ecosystem functions moderately fluctuated due to changes in parameters and climatic environments. Sensitivity analysis also indicated that the success and decay of a dominant species group that monopolized the canopy layer greatly affected those of a less-abundant, shade-intolerant group. This result indicates that even if environmental changes do not exhibit clear effects on dominant canopy species and/or whole forest structure, such changes may still substantially impact the biodiversity of subdominant species. In simulations without gap formation, woody biomass was overestimated and a shade-intolerant species group was eliminated. This finding indicates that incorporating gap formation into the individual-based model is essential for the appropriate simulation of forest biomass and biodiversity in this Malaysian tropical rain forest.

**Keywords:** Dynamic Global Vegetation Model, Biogeochemical cycles, processes, and modeling, Forest structure, dynamics, and functions, Tropical rain forest in South-East Asia, Response of biodiversity to climatic change

## **Schroth Goetz**

### **Sustaining livelihoods in conservation landscapes through ecosystem service rewards – examples from Mexico and Brazil**

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Contributed oral session O20, Economics of biodiversity 2

Ecosystem service rewards are a key instrument for integrating livelihoods and conservation at the landscape scale. There is an increasing diversity of reward mechanisms, comprising market driven as well as government managed schemes. This presentation reviews two ongoing projects supported by Conservation International using multiple incentives to promote human wellbeing in conservation landscapes. In the Sierra Madre de Chiapas, Mexico, conservation best practices in shade coffee production that help farmers access specialty coffee markets are now being complemented by a program helping communities to access voluntary carbon markets as well as government payments for reforestation and forest conservation. A next phase, under development with the GEF, will focus on strengthening micro-watershed councils to locally integrate resource conservation and climate change adaptation in these as well as downstream communities. In the second example from the Brazilian Amazon, a project has recently helped inhabitants of an extractive reserve (in itself a mechanism to reward local people for their conservation commitment through tenure security and some government support) to access a market for reforestation credits under a Brazilian law requiring companies to offset timber use from unsustainable sources. Reserve inhabitants complement their income by reforesting their land with native trees and selling credits (not trees) to local companies, simultaneously laying the basis for a future “agroforestry economy”. This pilot scheme is now being scaled up through a grant from the World Bank’s Development Marketplace. However, complicated and changing legislation remains a challenge. The examples show that even where environmental service reward programs and eco-markets exist, communities need support to access them, which can be an important role for local NGOs.

**Keywords:** environmental services, environmental governance, human wellbeing, watershed management, agroforestry

## **Schröder Kristin, Rajmis Sandra, Barkmann Jan, Marggraf Rainer**

### **Economic valuation of functional biodiversity services in Central German forest ecosystems**

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Contributed oral session O1, Economics of biodiversity 1

#### **Background and goal of study**

For single aspects of biodiversity, e.g. the conservation of certain species, numerous economic valuations exist. However, biodiversity is also considered as a protective mechanism against ecological risks that may occur in the future but are not yet known. Hence, as a new approach we investigate the preferences for forest biodiversity as an insurance mechanism against unknown risks. We compare the preferences for insurance against unknown risks with those for known risks, and study the motives behind them. For this purpose we adopt two social psychological theories (value-belief-norm, protection motivation) to investigate the influence of individual psychological factors on preferences (willingness to pay, WTP).

#### **Materials and methods**

We assessed WTP for several forest ecosystem services concerning protection against ecological risks in the Hainich forest area (Thuringia, Germany) in 2006 (n=302). In summer/fall 2009 we extend the study by including a focus on explaining WTP by underlying values, attitudes and beliefs of local residents of ten counties in the federal states of Thuringia and Lower Saxony (n~300). Both studies are based on the stated preference methodology (choice experiment).

#### **Results and discussion**

Nested Logit analysis identified an annual WTP between 8.96 €/year (aggressive invasive species control,  $p < 0.05$ ) and 25.72 €/year (resistance and resilience against insect pests and storms,  $p < 0.001$ ). Forest biodiversity-based measures for improvement in general insurance services against unknown risks are valued at 15.72 €/year ( $p < 0.001$ ). In the oral presentation psychological factors underlying these economic preferences will be presented.

#### **Conclusion(s)**

In the Hainich region societal benefits from biodiversity-based ecosystem insurance services are about 15.72 €/household year. An extension to the size of the Thuringian and German population allows an estimation of benefits of about 17.9 Mio €/year and 624 Mio €/year, respectively.

**Keywords:** Economic valuation, Stated preference, Ecosystem services, Ecological risks, Motives for WTP

**Soppa Mariana**, Gherardi Douglas, Souza Ronald**Brazilian coral biodiversity and its relation with climate variability**

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Contributed oral session O10, Projecting 21st century biodiversity change

This work presents a study of climate variability of the Brazilian reef ecosystems and its relation with coral biodiversity. Nine regions of coral reef occurrence in Brazil were investigated using satellite-derived and reanalysis data. Time series of space-averaged, monthly climatological variables were produced for the period between 1985 and 2004. The considered variables are: sea surface temperature (SST), precipitation, outgoing long wave radiation (OLR) and surface wind. The climate variability of the study areas was estimated applying the Assymmetric Fragmentation Operator (FA) on the available time series. The results suggest that the southern and northern areas of the Brazilian northeast region present distinct patterns of climate variability. The southern areas present a higher variability indicated by a higher value of FA in comparison to the northern areas. This difference was confirmed by the analysis of multidimensional scaling, similarity and principal components. The biodiversity of the coral species was determined from the estimation of the average taxonomic distinctness and the species number. The southern areas presented a lower average taxonomic distinctness and a larger species number than the northern areas. In order to answer the main question about the relation between the climate variability and coral biodiversity, the Spearman correlation analysis was carried out. The results suggest that there is a larger coral taxonomic distinctness at areas where FA variance is larger. A larger amount of coral species also tends to occur in areas presenting higher climate variability. The results of this study offer an unprecedented characterization of the relation between climate variability and Brazilian coral biodiversity.

**Keywords:** Brazilian coral reefs, biodiversity, climate variability, South Atlantic Tropical Ocean, Assymmetric Fragmentation Operator

**Spear Dian**, Marais Elrike, Mcgeoch Melodie**Challenges to the development of a global indicator for invasive alien species**

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Contributed oral session O19, Biodiversity indicators

**Background and Goal of Study**

Invasive alien species (IAS) are a major threat to biodiversity and as a result trends in IAS was selected as one of 22 Headline Indicators to measure progress towards the Convention on Biological Diversity's (CBD) target of reducing the rate of loss of biodiversity by 2010. The number of IAS in a country has been proposed to measure progress towards goal 6 of the CBD framework, to control threats from IAS.

**Materials and Methods**

These indicators have been populated for a stratified-random selection of countries. We assess the comprehensiveness of global IAS databases. We also determine the usefulness of the approach adopted to date for populating the invasion status indicator.

**Results and Discussion**

The major challenges facing the population of the indicators are data availability and quality and the lack of transparency of criteria used to designate species as invasive. The approach used to date to populate the invasion status indicator, although most practical based on time and resource constraints, provides a different list of species than lists of species suggested by invasive alien species experts.

**Conclusion**

This suggests that to provide a comprehensive assessment of the global status of IAS, expert input is required for countries globally.

**Keywords:** expert knowledge, indicator development, invasive alien species, data availability, definitions

**Subade Rodelio**, Jugado Evelyn**Effect of Payment Vehicles in Contingent Valuation Survey for Conserving Endangered Species and Habitats of Northwest Panay Peninsula, Philippines**

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Contributed oral session O1, Economics of biodiversity 1

The study aimed to determine the effects of payment vehicles in contingent valuation surveys for conserving endangered species and habitats of Northwest Panay Peninsula, Philippines (NWPP-NP). A total of 1200 respondents were surveyed and were asked to indicate if they

are willing to pay for the conservation of endangered species and habitats of NWPP through two payment vehicles; a surcharge on their community tax (Ced) or electric bill (Elec). Results showed that income was found to be significantly affecting willingness to pay (WTP) in all data set regressions-across two payment vehicles and is positively signed. Familiarity with endangered species is also positively affecting WTP of Ced respondents but not on Elec respondents. On the other hand, WTPyr or bid price is not significantly affecting Ced respondents but significantly affecting Elec respondents. This means that regardless of bid price or amounts, still less Ced respondents were willing to pay for the conservation of endangered species and habitats. Elec respondents on the other hand were protesting on the surcharge and as bid price increases, less were willing to pay for the conservation thereby confirming the law of demand. This study documented and found that in urban San Jose Antique and Kalibo, Aklan, Philippines (consisting of about 22,267 households), people have a high level of awareness of the importance of endangered species conservation. However, when asked for specific (monetary) commitment, the majority was unwilling or non-committal. Based on the dichotomous choice CVM survey, results confirm the low WTP of respondents since only up to 14 percent were willing to pay for the hypothesized conservation fund for NWPPNP's endangered species and habitats. This is almost the same portion as those who were willing to pay through either of the payment vehicle groupings.

**Keywords:** Contingent valuation, endangered species conservation, payment vehicles, willingness to pay, Northwest Panay Peninsula

### **Teixeira Carlos, Domingos Tiago**

#### **Trade-offs between biodiversity conservation and agricultural production targets: the case of Castro Verde's avifauna**

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Contributed oral session O3, Agrobiodiversity

#### **Background and Goal of Study**

Land use change is a major cause for biodiversity loss worldwide. This relates to human activities, such as agriculture. Considering that the human population is predicted to continue to rise with rapidly increasing per capita consumption, it becomes clear that knowledge concerning the trade-offs between biodiversity conservation and production or economic targets, is of prime importance for decision making in the twenty-first century.

We aim to assess how different land use options may provide different results in terms of avifauna conservation, production and economic value.

#### **Materials and Methods**

Life-history data were gathered for bird species present in the region of Castro Verde, an area of about 64,000 ha in the South of Portugal, with a landscape dominated by a mosaic referred to as cereal steppe or pseudo-steppe. A spatially explicit model previously developed was applied. In the absence of available data, mathematical inferences were made from closely related species. The Dynamic Energy Budget (DEB) theory was also used to model the species and provide metabolically based estimates.

Minimum areas of habitat were calculated, as well as the economic value of the agricultural production yields, and of the species themselves. Different land use options were then compared.

#### **Results and Discussion**

Results suggest that in some cases, the decrease in yield that results from the application of "wildlife-friendly farming" may be economically compensated by the added value provided by the presence of those bird species. In other cases, land sparing may still be the best option, as long as minimum habitat areas are available.

#### **Conclusions**

The use of rigorous estimates and the application of spatially explicit models, coupled with economic assessments (of production, biodiversity and ecosystem services) may provide the required knowledge for decision making aimed at the fulfilment of biodiversity conservation and economic targets.

**Keywords:** Biodiversity conservation targets, Agricultural production and economic targets, Intensification versus Extensification, Wildlife-friendly farming versus Land-sparing, Decision-making

**Tesfamichael Dawit**, Pauly Daniel, Pitcher Tony

**Integrating Local Ecological Knowledge (LEK) and Ecosystem Modelling to assess the past and predict the future of biodiversity in the Red Sea**

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Contributed oral session O13, Conservation, conflicts resolution and development

Coastal communities in the Red Sea depend heavily on the ecosystem for their livelihood and have caused changes to the biodiversity. However, there is no data recording system and research to objectively assess the changes. Being an oral tradition society, most of the knowledge of the past is available mainly in people's memory. A semi-structured interview was, therefore, used to harness the Local Ecological Knowledge (LEK) in order to assess the changes to the ecosystem in general and biodiversity in particular. The results indicated fishery to be the main cause of changes to the ecosystem and its effect was exacerbated with the introduction of motors to the local fishing fleets. The results also showed shift in the baseline of what is perceived as a "healthy" ecosystem by different generations, which is key in setting future policy objectives. The results of the interview were combined with an ecosystem model to predict what will happen to the biodiversity at different scenarios of exploitation by the fishing industry. An ecosystem modelling tool Ecopath with Ecosim (EwE) was used to quantify the trophic interaction throughout the ecosystem, including human, with special emphasis given changes due to fishing. Based on the combined results of the model and interviews, simulations were done on a wide spectrum of fishing scenarios: from complete closure to open access and different combinations of artisanal and industrial fisheries, and their consequences in the ecosystem and livelihood of the coastal communities were predicted. Trade-offs were quantified in ecological (biodiversity and biomass), economic (revenue) and social (number of employment) aspects of the management options. The results can be used to guide policies with different objectives and their possible consequences to the ecosystem and the livelihood of the coastal communities at the present and for future generations.

**Keywords:** Biodiversity assessment, local ecological knowledge, ecosystem modelling, policy choices, Red Sea

**Thyresson Matilda**, Nyström Magnus, Crona Beatrice, De La Torre Castro Maricela, Jiddawi Narriman

**Exploring socio-economic drivers in coral reef fisheries: a functional group approach**

Stockholm University, Systems Ecology, Sweden

Contributed oral session O11, Biodiversity and ecosystem functioning 2

**Background and goal of study**

Over fishing is considered to be one of the major causes behind the decline of coral reefs and with a growing human population and expanding tourism industry in the coastal zones the demand for reef fish is constantly increasing. Furthermore reef-resources are becoming increasingly attractive on the global market. The exploitation of some reef fish, such as parrot fishes and groupers, clearly illustrates a mismatch between their important role as functional groups in the ecosystem and the global demand for them. Thus it is critical to identify socio-economic drivers of different functional groups of reef fish and the scales at which these drivers may act upon. This study aims to identify and link socio-economic drivers (e.g. subsistence provision, market demands, and tourism industry) of exploitation to ecologically important functional groups of reef fish that maintain key ecosystem processes on coral reefs.

**Materials and methods**

The study was conducted on Zanzibar at two occasions in November-December 2007 and January, November 2008. To capture how different functional groups and size-classes of reef fish were sold, semi-structured interviews were conducted with 150 respondents (e.g. fishermen, middlemen and hotel managers) involved in the coral reef fisheries. Furthermore, key-informant interviews were done with fisheries managers and participatory observations were done on fish landing sites and at markets.

**Results and discussion**

The results suggest that various drivers operating at different scales (i.e. locally, regionally and globally) lie behind the exploitation of different size-classes of functional groups.

**Conclusion**

These results imply that different management strategies are required to cover the range of ecosystem processes, that underpin coral reef functioning.

**Keywords:** Socio-economic drivers, Over fishing, Coral reefs, Functional groups, Fish

**Torquebiau Emmanuel**, Ferguson Willem**The biodiversity value of contrasted farming practices in KwaZulu-Natal, South Africa**

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Contributed oral session O3, Agrobiodiversity

**Background and goal of study**

The impact of agriculture on biodiversity has been recognized in several recent studies. Our goal was to determine the impact of small scale farming on biodiversity, based on a case-study in South Africa, where contrasted farming practices can be found in close proximity.

**Materials and Methods**

The Province of KwaZulu-Natal has a mix of farming practices including crop, livestock and small scale, mostly subsistence farming, making it a relevant situation where the relationship between agricultural practices and biodiversity can be studied. Typically, small-scale farming forms a mosaic of land uses, as opposed to commercial farming with homogeneous land use. We used the South African bird atlas data set at a resolution of ¼ degree and the South African land cover map to make a spatial analysis of bird abundance and diversity against farming practices.

**Results and Discussion**

With the exception of lower bird species richness in the savanna bioregion, our results show that bird species richness, abundance and community structure do not significantly differ across areas under commercial farming, subsistence farming and nature conservation. The only significant differences were attributable to vegetation types, represented by the four main bioregions. Taking into account the high human population density in subsistence farming areas, this was not expected and shows the potential of these areas for biodiversity conservation. The heterogeneous land use mosaic characteristic of small scale farming allows for islands of suitable habitats for many bird species, thus contradicting a common idea that biodiversity and subsistence farming are in opposition.

**Conclusion**

Given the importance of conserving biodiversity in agricultural landscapes, and not only in protected areas, our results emphasize the need to encourage sustainable farming practices with high spatial heterogeneity in order to maximise the number of habitats for wildlife.

**Keywords:** Agrobiodiversity, Farming practices, Birds, Small scale farming, South Africa

**Tremblay Yann****Biologging and conservation biology**

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Contributed oral session O17, Conservation planning 2

The marine environment does not permit us to observe marine life for prolonged periods of time. Biologging science allows us to do so. By electronic-tagging an animal, we are now able to measure a number of important behavioral and physiological parameters. These parameters can be used in conservation biology in a number of ways. What is fundamental is that biologging science is based on data collected at the individual level, whereas conservation biology traditionally uses data collected at the population level. In the same way, biologging science provides data for behavioral or ecological studies, with less focus in conservation biology. In this talk I will show how behavioral data can be used with a conservation perspective, and I will discuss pitfalls and limitations of such an approach. I will further discuss the perspectives of biologging science in conservation biology.

**Keywords:** Biologging science, conservation biology, tracking, behavior, tagging

**Tschirhart John****Deriving Growth Functions for Harvesting with Multiple Species**

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Contributed oral session O20, Economics of biodiversity 2

**Background**

Ecologists have referred to species growth functions as the most important product that scientists can deliver to fisheries managers. However, economists have traditionally used very simple, single-species growth functions, such as the logistic function, when designing optimal harvesting policies. More realistic growth functions that have important implications for harvesting are needed.

**Methods**

One approach is to derive growth functions based on the behavior of individuals in predator and prey species. But most studies of individual organism behavior ignore population dynamics, and most studies of population dynamics ignore individual behavior. In contrast, using a multi-species model in which the behaviors of individual organisms determine population dynamics, we derive species' growth functions that exhibit nonconvexities instead of the usual strictly concave shape of the logistic function. In order to understand multispecies systems, feeding rates, or functional responses, should be tied to individual behavior by including adaptive predator as well as adaptive prey behavior. Functional responses are emergent properties in the model, no responses are assumed at the outset, in contrast to most predator-prey and switching models that assume a Holling Type II or III response.

**Results**

When predators are saturated in all prey, growth is increasing in density and density independent, but becomes density dependent when predators are non saturated in at least one prey. Predator exploitive competitions for prey species are measured by the energy costs of consuming prey, with higher costs defining increased competition. The derivation illustrates how non convexities are determined by individual predators' consumption of prey species, and on predator competition and switching behavior. The non convexities imply depensation which can yield multiple, unstable harvest equilibriums. An illustration uses an 18 species marine ecosystem in the Eastern Bering Sea.

**Keywords:** Growth Functions, Harvesting, Multiple Species, Nonconvexities, Predator Switching

**Upreti Bishnu****Impacts of armed conflict on biodiversity in Nepal**

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Contributed oral session O12, Drivers of biodiversity 2

This paper explores impacts of ten years of armed conflict on biodiversity in Nepal. The main objective of this paper is to analyze the patterns of practices used during the time of the armed conflict by the government, insurgents and people and their relations with biodiversity. First, this paper briefly presents conflict dynamics and then examines major environmental causes of the armed conflict and its impact on biodiversity (protected areas and wildlife, forests, and genetic resources). Further, biodiversity impacts in the Peoples Liberation Army cantonments have been discussed. Finally this paper highlights innovative ways and means used to address biodiversity challenges faced by Nepal due to the armed insurgency.

The study was conducted in 5 districts of Nepal from May to December 2007 by using qualitative and quantitative methods and supplementary data was used from the earlier study of the author in other 7 districts.

The field study reveals that local people can develop innovative response strategies and effectively implement them even during periods of violent conflict. They were able to deal with the rebel groups and state security forces to minimize the negative impacts on biodiversity and environment. Based on the analysis of different cases, the paper argues that once local people are organized and promote a 'social and geographical audit' to maintain transparency and accountability, the obstruction from warring parties is reduced. One of the most effective mitigating options observed was the adaptation of a flexible approach and continuous adjustment of the operation to respond to the conflict situation. The paper concludes that local communities, with appropriate training and backstopping from researchers can develop an innovative set of knowledge, skills and competences as well as operational strategies and flexible approaches to respond to a conflict situation.

**Keywords:** biodiversity, conflict, community, knowledge, Nepal

**Urgenson Lauren, Prozesky Heidi, Esler Karen****Multi-Stakeholder Assessment of Alien Invasive Plant Clearing on Private Land in the Western Cape, South Africa**

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Contributed oral session O16, Biodiversity governance

**Background**

There is growing recognition that conservation paradigms focused solely on land preservation are insufficient to halt the loss of earth's biodiversity and natural resources. In recent years, ecosystem services concepts have been embraced by conservation organizations world-

wide. Ecosystem services programmes focus on the incorporation of conservation into production landscapes through creation of novel incentives and disincentives that align conservation and economic goals. Despite increased prevalence, there is limited evidence demonstrating the effectiveness of these programmes.

South Africa's Working for Water (WfW) is globally recognized for combining alien invasive plant management (IAP) with job creation in previously disadvantaged communities. Private land-user involvement has been identified as a limiting factor in the long-term success of this programme. WfW has developed a new policy combining social and economic incentives and disincentives to promote private land-user clearing of IAP. This policy requires a major shift in the rights and roles of land-users and the agencies working with them. Success will depend on its ability to address the perceptions and constraints facing these stakeholders.

### **Goal of study**

Study goal is to describe perceptions of landowners, WfW managers, and local conservation professionals regarding the greatest barriers to IAP clearing on private land in the Western Cape. We will compare perceptions across stakeholder groups to identify potential strengths and limitations of WfW's new approach.

### **Materials and methods**

We use a combination of personal interviews, focus group interviews, and e-mail surveys.

### **Results and Discussion**

Study results will 1) Provide WfW with monitoring information to feed into future policy implementation and 2) Contribute to the international literature evaluating the potential effectiveness of an ecosystem service approach to off-reserve conservation.

**Keywords:** plant invasion, private land, ecosystem services, Working for Water, incentives

**Vackar David**, Moldan Bedrich

### **Biodiversity in sustainability indicators and environmental accounting**

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Contributed oral session O19, Biodiversity indicators

### **Background and Goal of Study**

Many biodiversity indicators have been developed during the last decades, especially in the framework of the CBD's 2010 target. Despite progress in the biodiversity indicators area, their resonance and use in everyday decision-making is still rather limited. One of the main underlying problems is that biodiversity is usually omitted in recent revisions of national accounting systems. The main question of our analysis is to detect divergences as well as synergies between biodiversity indicators and sustainability accounting.

### **Materials and Methods**

We analyzed the components of main macro-indicators of environmental sustainability (for example, Environmental Performance Index, Ecological Footprint, Ecosystem Wellbeing Index, Genuine Savings) using a set of predefined criteria. The sub-indicators and input data were compared to the structure and input data of main biodiversity indicators such as Living Planet Index, Red List Index or Biodiversity Intactness Index. The analysis was based on the environmental accounting framework of the System of Integrated Environmental and Economic Accounts.

### **Results and Discussion**

The analysis revealed significant gaps in current sustainability and environmental accounting frameworks. Biodiversity is covered only partially in existing environmental accounting systems and sustainability indicators. Analyzed macro-indicators reflect mainly cultural role of biodiversity and omit life-supporting services of biodiversity. We further discuss reasons for biodiversity exclusion from environmental accounts.

### **Conclusions**

To develop sound biodiversity indicators, closer links to systems of national and environmental accounting should be developed. This would enable greater integration of biodiversity into decision-making and could contribute to the reduction of biodiversity loss and the designation of payments for biodiversity related services from which society benefits.

**Keywords:** Biodiversity indicators, Sustainability indicators, Environmental accounting, Environmental sustainability, Ecosystem services

**Van Rooij Wilbert****Biodiversity modelling as policy tool: National applications of GLOBIO3**

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Contributed oral session O2, Biodiversity science and policy

The Netherlands Environmental Assessment Agency has developed indicator models and monitoring tools for biodiversity assessments and evaluations to support policy makers. The most important questions that should be answered are: What is the current state of biodiversity, what are the causes of change, what is the future state, will we meet agreed targets and what can policy makers do? In order to get answers to some of these questions the GLOBIO3 model has been developed. This pressure based model calculates the relative Mean Species Abundance of original species (MSA) by calculating the impact of 5 major pressures on biodiversity: Land use change, Infrastructure, Fragmentation, Nitrogen deposition and Climate change. For each of these pressures dose - response relations have been established based on literature reviews in which a comparison is made between undisturbed and disturbed ecosystems. The original species abundance serves as natural reference.

GLOBIO3 was initially developed for global and regional assessments. As part of a capacity building scheme participants from several tropical countries have been offered courses in biodiversity modelling with GLOBIO3. Soon, requests were made to apply the model also at national scale. For this, detailed national datasets were used to improve the output resolution. In addition GLOBIO3 has been integrated with the CLUE model to determine the allocation of future land use based on scenarios and selected land use policies. In subsequent courses participants from more than twenty countries have been trained and resulted in biodiversity assessments for 14 tropical countries. First results are presented together with suggestions on how to improve the model. In addition, a few examples are given of problems with embedding the model in policy processes. It appears that for a successful implementation of the model as a support tool for policy makers capacity building needs to be carried out both bottom up and top down.

**Keywords:** Biodiversity, Pressure modelling, Mean species abundance (MSA), Policy support tool, GLOBIO3

**Van Vuuren Bettine, Robinson Terence, Matthee Conrad, Vazpinto Pedro, Estes Richard****Phylogeography of sable antelope: model to understanding Southern African Biogeography**

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Contributed oral session O15, Analysing patterns and trends

The giant sable (*Hippotragus niger variani*) is one of Africa's most spectacular large antelopes. Years of civil unrest in Angola, a highly localized distribution and suspected interbreeding with its congener the roan antelope (*H. equines*), has led to this subspecies being considered as critically endangered. Sable antelope occurring ~ 600 km to the east in western Zambia resemble the giant sable in phenotype, prompting speculation that the distribution of giant sable may be larger than currently documented. An analyses of molecular variance indicated significant genetic structure across the pan-African range of sable antelope ( $F_{ST}=0.857$ ,  $p<0.001$ ) and revealed several distinct lineages in Southern Africa. Using molecular techniques, we estimate the time of lineage divergences amongst these lineages, and place our findings in the context of Southern African biogeography. Our findings hold implications for the conservation of sable.

**Keywords:** Hippotragus, coalescence, mtDNA, biogeography, phylogeography

**West Adam, Dawson Todd, February Edmund****Drought responses in fynbos species: improving predictions for a highly diverse flora**

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Contributed oral session O12, Drivers of biodiversity 2

Climate change induced shifts in ecosystem water balance may have profound consequences for biodiversity in many regions around the world. In the Cape Floral Region (CFR) of South Africa, one of the six plant kingdoms of the world, future climate simulations predict warmer temperatures and a reduction in precipitation in the west, leading to more frequent and intense periods of drought. A change in the duration and intensity of drought is likely to severely impact the CFR as this flora appears to have radiated in relatively mesic and stable climate conditions, is highly endemic and has limited migration potential. However, uncertainty in climate predictions (particularly for precipitation) coupled with limited experimental data to test species' environmental thresholds, leaves us with very little information about what the specific impacts may actually be. We conducted a rain-exclusion experiment to assess the responses of the three main growth types in the fynbos (proteoids, ericoids, restioids) to drought. Following severe summer drought there were marked differences in the responses of the growth forms. The anisohydric Ericas were most severely impacted, showing markedly reduced gas exchange, growth and flowering under drought stress, while the isohydric proteoids and restioids were less affected. Using a recently developed theoretical framework of plant responses to drought, together with our experimental data, we explore the potential for improving our predictive capability of drought-related impacts in the CFR. We show the potential for detecting categories of plant responses to drought that will improve our ability to predict the impacts of future climate in the region.

**Keywords:** drought, fynbos, climate change, rain-exclusion experiment, ecophysiology

## Westneat Mark

### **The power of tree visualization for biodiversity data integration**

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Contributed oral session O6, Biological diversification

Rapid access to information is a defining revolution of our time, and computational visualization techniques will help us to see that revolution more clearly. This is true of all fields in biology, as the growth of information on species, geography, genetics, evolution and ecology transcends our ability to analyze and detect key patterns. In particular, the life sciences are being transformed by the rapid growth of phylogenetics and advances in related computer sciences. The large data sets that are used to generate phylogenetic trees, the complex tree topologies themselves, and the power of viewing large data sets through a phylogenetic lens to explain life on our planet are now a centerpiece of biology. A significant challenge in the effort to see new patterns and achieve quantum leaps in knowledge is the need for novel ways of viewing large, branching phylogenies of hundreds or thousands of species. To address this challenge, we are developing ways of visualizing large phylogenetic trees with a multiscale structure to aggregate and organize data. While intuitive from a biological perspective, using a phylogenetic tree as an organizing map controlling aggregation and level of detail for visual representation is a significant computational challenge and represents a frontier in visualization. New visualizations of evolutionary data can enhance human ability to extract information and avoid cognitive overload using several techniques such as focus+context viewing, hyperbolic lensing, and linked viewing, technologies that enhance the performance of human pattern recognition, scientific insight, and ease of use in software applications. Large bioinformatics projects provide opportunities for biologists to aggregate multiple kinds of information about organisms, and will create new ways of conceiving and visualizing biodiversity information, provided they contain a solid hierarchical, phylogenetic framework and novel ways to visualize their rich content.

**Keywords:** phylogeny, visualization, cognition, informatics, evolution

## Weyl Olaf, Booth Anthony, Traas Graham

### **Cutting losses and aligning priorities in developing a management plan for freshwater fishes in a South African national park**

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Contributed oral session O8, Conservation planning 1

#### **Background**

In South Africa, indigenous freshwater fishes are threatened by the regulation of flow regimes, pollution and by inter-specific competition and predation by and competition with alien invasive species. The current project assessed the status of freshwater fishes in the Addo Elephant National Park in the Eastern Cape Province of South Africa to develop management recommendations for their conservation.

#### **Methods**

We surveyed more than 100 sites to correlate the presence and relative abundance (PRA) of indigenous fish species with habitat, presence of alien fishes and barriers to migration.

#### **Results & Discussion**

The indigenous ichthyofauna comprises four *cyprinids*, including the endangered endemic East Cape redbin minnow *Pseudobarbus afer*, two Anguillid eels, a freshwater mullet *Myxus capensis* and a goby *Glossogobius callidus*. The river is heavily impacted by an interbasin water transfer that has altered the flow regime and functions as a conduit for downstream invasion by alien fishes from a 4000ha upstream impoundment. Invasion was a downstream process that could not be contained in the mainstream of the river. Subsequent upstream invasion by aliens into tributaries had occurred up to natural or manmade barriers and the PRA of alien fishes was most influenced by connectivity between habitats. The PRA for indigenous small cyprinids was negatively correlated with that of alien invasive fishes. The barriers restricting upstream invasion by alien piscivorous fishes also impeded migration of the catadromous *M. capensis* and the mottled eel *Anguilla marmorata* but less so for the longfin eel *Anguilla mossambica*. These results are discussed with direct reference to the park's aim to conserve a representative sample of Eastern Cape ecological patterns and processes and ensure the long term persistence of biodiversity.

#### **Conclusions**

Invaded mainstream habitats and migration corridors need to be sacrificed to protect endangered fishes in upper catchments

**Keywords:** fish, endangered, invasion, inter basin water transfer, prioritisation

**Wilhelm-Rechmann Angelika, Cowling Richard****Furthering implementation of systematic conservation plans in the Eastern Cape, South Africa: social marketing, behavior change and land use planning**

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Contributed oral session O4, Managing biodiversity with a social-ecological system focus

Highly sophisticated Systematic Conservation Plans are available in the Eastern Cape province, South Africa. However, influence of these plans on the land use planning procedures at local government level appears to remain limited.

To further implementation of Systematic Conservation Plans a social marketing approach has been used in four coastal Municipalities. Social Marketing is the strategic application of highly successful marketing technologies to further societal good instead of commercial gain. The aim was to forge a partnership with local land use planners and to convince them to change their behavior and meaningfully integrate the biodiversity maps in their work processes. Firstly the reasons for non-adoption and the perceived and possible benefits of using the maps have been investigated in a formative research process. Based on these insights, a strategic promotional program is being developed using a variety of insights gained in conservation psychology. Concurrently, the problems with and barriers to using the biodiversity maps are being addressed. The primary barrier for the land use planners proved to be the lack of support from their hierarchy, i.e. the political level. Therefore, the project has been extended to the locally elected Councilors as an additional target group to explore how they perceive biodiversity protection: our interviews have shown, for example, that the terminology and the concept of "biodiversity" are largely not understood or not even established in the Councils. Conversely, the sustainability concept is very well established, but remains largely unconnected to the natural environment. Our findings offer a basis for framing biodiversity protection more successfully and for defining clear behavior change goals for local municipalities. This ongoing behavior change project presents an instance of applying conservation psychology to understand and shape actions targeted at the societal side of the science-policy interface.

**Keywords:** Systematic conservation planning, social marketing, behavior change, implementation, land use planning

**Williams David E****On-farm conservation of indigenous crops contributes to rural development goals in the Ecuadorian Andes**

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Contributed oral session O18, Ecological restoration

Kichwa farmers in northern Ecuador were becoming concerned about the gradual loss of their ancestral knowledge and native crops. A multidisciplinary project was conceived, based on a complementary approach (in situ + ex situ), to help reconcile the conservation of local agrobiodiversity with the development goals of the native communities. A rapid assessment of the communities confirmed the persistence of a significant amount of indigenous diversity and associated knowledge despite the recent loss of some traditional crops and varieties, and revealed the native farmers' keen interest in recovering those components of their agricultural heritage. Project activities included restoration of abandoned crops and varieties from materials conserved in genebanks, adding value and promoting the use of native crops through innovative approaches, and developing an agrobiodiversity teaching module for the communities' bilingual schools. Noteworthy outcomes and impact indicators include the enrichment of dozens of home gardens with native crops, which was linked to a notable decrease in those families' consumption of processed store-bought foods, and which had a spill-over effect on neighboring families who opted to diversify their own home gardens to reap similar economic, nutritional and aesthetic benefits. New sources of income were perceived by scores of households involved in the production, processing and marketing of native crops, the production and sale of handicrafts based on local agrobiodiversity, and agrotourism. Most importantly, the project was instrumental in achieving heightened awareness and formal recognition of the importance and value of native crops by the region's indigenous authorities, as evidenced by their refocusing of a large agricultural development project—originally oriented towards technified monoculture of an introduced crop—to a diversified approach based instead on traditional production of high-value, organically grown, native crop species.

**Keywords:** Andean crops, on-farm conservation, agrobiodiversity, Ecuador, Kichwa farmers

**Williams Kristen J, Faith Daniel P, Cameron Susan E, Mitchell David K, Margules Chris R**  
**Systematic Conservation Planning and the 2010 Biodiversity Target: integrating biodiversity and socio-economic factors in Papua New Guinea**

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 Contributed oral session O19, Biodiversity indicators

The 2010 biodiversity target requires "a significant reduction in the rate of loss of biodiversity". We describe an effective approach to the 2010 target that overcomes limitations of standard biodiversity indicators. It is based on the expected gains arising from the trade-offs and synergies offered by "systematic conservation planning" (SCP). The trade-offs (through land-use choices among localities) and synergies (management regimes providing multiple benefits within localities) imply reduced conflict between biodiversity conservation and other land-use opportunities, leading to a reduced rate of biodiversity loss for a given rate of regional adoption of non-conservation land uses. This approach is explored for Milne Bay Province, Papua New Guinea, where current planning for biodiversity conservation focuses on Key Biodiversity Areas (KBAs). Our SCP assessments integrated KBAs with assessment of overall biodiversity, and explored trade-offs based on food security and macro-economic considerations. SCP results suggested regional scenarios corresponding to a reduced rate of biodiversity loss, and illustrated how the 2010 target can be addressed by integrating biodiversity planning with social and policy dimensions. Our study also highlights the utility of museum collections data, including data from the Global Biodiversity Information Facility (GBIF), for developing effective surrogates for overall biodiversity.

**Keywords:** land use planning, opportunity costs, GBIF, collections data, 2010 biodiversity target

**Wilson Kerrie**

**Conserving biodiversity in production landscapes**

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 Contributed oral session O22, Managing for ecosystem services

Alternative land uses make different contributions to the conservation of biodiversity, and have different implementation and management costs. Conservation planning analyses to date have generally assumed that land is either protected or unprotected and the unprotected portion does not contribute to conservation goals. We develop and apply a new planning approach that explicitly accounts for the contribution of a diverse range of land uses to achieving conservation goals. Using East Kalimantan as a case study, we prioritise investments in alternative conservation strategies and account for the relative contribution of land uses ranging from production forest to well-managed protected areas. We employ data on the distribution of mammals and assign species-specific conservation targets to achieve equitable protection. The relative sensitivity of each species to forest degradation determines the contribution of each land use to achieving targets. We compare the cost-effectiveness of our approach to a plan which considers only the contribution of protected areas to biodiversity conservation, and to a plan that assumes that the cost of conservation is represented by only the opportunity costs of conservation to the timber industry. By accounting for the contribution of unprotected land, we obtain more accurate estimates of the costs of conservation. Using traditional planning approaches overestimates the cost of achieving our conservation targets by an order of magnitude. Our approach reveals not only where to invest, but which strategies to invest in, in order to effectively and efficiently conserve biodiversity.

**Keywords:** Spatial prioritisation, East Kalimantan, Timber, Forest management, Marxan

**Zarzycki Tomasz, Ressurreição Adriana, Punt Maarten, Dentinho Tomaz, Szaniawska Anna, Austen Mel**

**Combining biological and economic valuation approaches to valuing marine biodiversity in the Polish part of the Gulf of Gdansk, Baltic Sea**

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 Contributed oral session O20, Economics of biodiversity 2

Degradation and fragmentation of habitats leads to biodiversity loss and consequently, a decrease in the provision of goods and services that arise from healthy marine ecosystems. An assessment framework of socio-economic and ecological valuation of marine biodiversity change was implemented in the Polish part of the Gulf of Gdansk (Baltic Sea) in order to develop a decision support system (DSS).

The stated preferences method was used to estimate the value of a marginal loss of biodiversity in the Gulf of Gdansk through a survey designed to capture the Willingness To Pay (WTP) of inhabitants and visitors, to prevent a decrease in biodiversity in the region. As a proxy for the complex context of biodiversity, the number of marine species in the region was used.

To determine biological (intrinsic) value in the Gulf of Gdansk, the study area was divided into a number of sub-zones and analysed by applying an assessment framework based on the following criteria: rarity, fitness consequences and aggregation. Databases on macrozoobenthos, fish, birds and macrophytobenthos, were analysed and processed. The intrinsic biological value of each sub-zone was assessed and scored relative to the other sub-zones.

The results of economic valuation show that people allocate monetary value to marine biodiversity protection measures. People's WTP varies between introduced biodiversity decrease scenarios. Results of marine biological valuation will be presented on maps using GIS. These valuation maps indicate the areas with high biological value and support identification of possible conflicts between human uses and the environment. The challenge of this research was to combine different scientific currencies into a consistent decision support system. The unique connection between social and natural sciences is considered crucial for efficient biodiversity conservation.

**Keywords:** economic valuation, marine biodiversity, CVM, intrinsic value, decision support system

# Posters

**Abdelaziz Lawani****Contribution of wood energy to sustainable livelihood of the riverside households of the Biosphere Reserve of Pendjari (BRP)**

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Poster session P11, Conservation, conflicts resolution and development

**Background**

Development efforts so far have been focused on the strengthening of forests, without considering their interaction with other goods in peoples' livelihoods, particularly the poor. Nowadays, it is commonly recognized that riverside's populations, especially poor people, depend on the forest for their survival

**Goal of study**

1. Examine the ways wood energy is used, and help to reduce households' vulnerability by contributing to create income opportunities;
2. Evaluate the importance of the income generated by the exploitation of such a product in the households' income and the impact of that exploitation on the welfare of the households.

**Materials and methods**

The study used a theoretical framework developed by Carney: The Sustainable Livelihood Analysis. Second, the explanatory factors of populations' dependence on wood energy were analysed with a descriptive approach and an econometric model: The Tobit model

**Results and discussion**

After carrying out a survey which took into account 120 households of 8 villages, 21 focus groups were organized. We succeeded to show that Non Timber Forest Products (NTFP) with a mean revenue of 69.795,83 FCFA per year, wood energy generates more income than sorghum, millet, cassava and peanut. The income generated by this NTFP is used to get some inputs for others activities which contribute to the livelihoods, such as seeds purchase, agricultural wage cost support or the creation of funds for others trading activities. Factors, such as the size of the household, the level of poverty, and the income of the household minus the income derived from wood energy, explain the dependence of households on this product, and the quantities used become more and more important due to the increase of the population. If nothing is done, in fifteen years the population will be facing a severe energy crisis

**Conclusion**

Wood energy is an important product in the households' incomes and especially poor people depend on this product for their survival.

**Keywords:** wood energy, livelihood, poverty, biosphere reserve of pendjari, household

**Abdullah Saiful Arif, Mohd Yusof Abdul Malek, Md Nor Shukor****Developing categorization system of protected areas in peninsular Malaysia for sustainable biodiversity conservation**

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Poster session P08, Conservation planning

**Background and goal of study**

Globally, the establishment of protected areas is mainly for the protection and conservation of wildlife, unique ecosystems and historical or cultural heritage. In peninsular Malaysia, the protected area is arbitrarily assigned to gazetted forested areas, marine or other natural habitats managed by different government departments and/or agencies at the State and Federal levels. However, thus far, there is no explicit categorization system of the protected areas in the country. This has caused a misunderstanding of what has been declared as protected areas, which may hinder sustainable biodiversity conservation. Therefore, the objective of this study is to develop a systematic category of protected areas in peninsular Malaysia.

**Materials and methods**

The approach includes reviewing and analysing the existing literature on the institutional management of the managed areas.

**Results and discussion**

Based on the approach, five attributes have been identified to develop the categorization system. The attributes include: type of ecosystem, management unit, legislative status, ecological function and institutional. The developed system suggests that protected areas in peninsular Malaysia can be divided into four categories; Permanent Forest Reserve, Wildlife Reserve, State Parks and Marine Protected Area.

**Conclusion**

In essence, each category of protected area has their specific role and objective but the one common goal is biodiversity conservation. Thus, an explicit systematic category is vital to achieve a system of sustainable biodiversity conservation of protected areas in peninsular Malaysia.

Keywords: Biodiversity management, Land use, Ecosystem management, Wildlife conservation, Protected area system

**Adano Wario****Forest fragmentation, ecosystem services and human health under climate change risks, Northern Kenya**

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Poster session P12, Biodiversity and climate change

Forests in Kenya have recently been put under serious threats of excision and land-use change, human encroachments and the soaring demand for forest resources. The connections between these issues and their consequences for ecosystem services have not been systematically investigated. This paper considers the ecosystem services of the Mt Marsabit forest, which is considered ecologically sensitive and a biodiversity hotspot area in northern Kenya. The local human population, rain-fed agriculture, livestock and floral and faunal biodiversity depend on the ecosystem-supported services. The paper uses household-level and secondary data to investigate the effects of converting forested areas into rain-fed agriculture on the ecosystem-supported water supply, crop production and on water-borne human diseases under climate change. Rainfall analysis shows a consistent downward trend over the past three to four decades, and more severe droughts than any similar decade ever before. We find increased forest conversions associated with reduced crop production and increased food insecurity, and increased cases of water-borne diseases and malnutrition levels under a downturn in rainfall. The changes in land-cover clearly explain significant variations of these variables, and the economic burden of human ill-health falls disproportionately on the relatively poor. The majority of the settling population on the mountain consisted of previously nomadic groups who lost their herds to the recurrent severe droughts. Today, the forest resources are becoming more important for settling nomads, while simultaneously suffering from increasing pressure as a result of the same settlement process. Any future increase in the populations may result in increased demand for farmland (and forest fragments) and intensified use of the resources at the expense of the health of forests' ecosystems. While the current disjointed legislations hamper cooperative arrangements and enforcements, the results of the paper call for urgent and effective harmonization of conservation policies and enforcement rules for achieving a sustainable use of ecosystem resources.

**Keywords:** Forest habitat, ecosystem services, climate change, human health, Kenya

**Adeniji Grace, Eweoya Olusegun****Assessing the environmental impacts of production and utilization of charcoal in Ibarapa North, Nigeria**

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Poster session P11, Conservation, conflicts resolution and development

**Background and goal of the study**

In developing countries, where improved energy supply for both domestic and industrial uses is not available, traditional energy supply will for a long time remain the source of domestic fuel for most rural, low and middle income households as it is evident in Nigeria. The most common of such energy sources are wood and charcoal, the production and utilization of which, has environmental impacts. It is against this background that the study assesses the environmental impacts of the production and utilization of charcoal in the Ibarapa North Local Government Area, Nigeria. Energy consumption for various purposes as well the demand and supply profile of the charcoal in the study area were examined with a view to suggest measures of ameliorating the negative impacts.

**Materials and methods**

An impact assessment was carried out to determine the various effects of the charcoal production and utilization process using the matrix method. Alongside with desk search, and direct observation and informal interaction with the charcoal producers, two types of questionnaires were administered to gather data from the sampled population; one for the consumers and the other for the producers of charcoal. Data were analyzed using the statistical Package for Social Science (SPSS).

**Result and discussion**

The analysis shows that charcoal production is having a negative impact on the environment of the study area. Deforestation was found to be the major outcome of charcoal production, which results in biodiversity loss, disruptions in local hydrology, soil deterioration, and air pollution.

**Conclusion**

The paper concludes by suggesting integrated forestry management through local reforestation, public enlightenment and pragmatic policy implementation on environmental conservation.

**Keywords:** charcoal, biodiversity, environment, sustainability, Ibarapa

**Aires Tânia**, Marbà Núria, Serrão Ester, Duarte Carlos, Arnaud-Haond Sophie

**Biotic interactions and the success of invasive species: the case of the bacterial flora of *Caulerpa taxifolia***

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Poster session P07, Biodiversity and ecosystem functioning

The invasive alga *Caulerpa taxifolia* exhibits an intriguing and diverse associated bacterial microflora that may have changed or evolved along the course of invasion, and possibly contributed to the success of this originally Australian species in the Mediterranean. The aim of this project is to make a first step towards understanding the possible role of these associated organisms in the success of their invasive host. This will be done by comparing the distribution of strains associated to *C. taxifolia* in its native range and in the Mediterranean, and comparing the bacterial communities associated with the three congeneric species (*C. racemosa*, *C. prolifera* and *C. taxifolia*) in the Mediterranean, when occurring in sympatry versus isolated. This second part will allow screening for the occurrence and possible impact of lateral transfer among species. Here we will focus on the across species comparisons in the Mediterranean Sea. The first results obtained using a variety of samples and extraction methods to obtain a preliminary assessment of the diversity and structure of bacterial communities as described on the basis of 16S characterization via 454 pyrosequencing. Spatial variation of bacterial communities is revealed across the Mediterranean Sea, as well as differences among *Caulerpa* species. This opens new perspectives to test the hypothesis of species versus habitat specificity for several lineages and supports the potential importance of the often neglected associated bacterial communities in the adaptation capacities and the fitness of their hosts.

**Keywords:** *Caulerpa*, Invasive species, Bacterial communities, Endosymbionts, Metagenomics

**Ait Baamrane Moulay Abdeljalil**, Znari Mohammed, Naimi Mohamed, Loggers Chris,

El Mercht Said

**Conservation and management of an isolated remnant population of Moroccan Dorcas Gazelles North West of the Atlas Mountains**

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Poster session P08, Conservation planning

Dorcas gazelle, *Gazella dorcas* (Bovidae: Antilopinae) is globally considered as vulnerable. In Morocco, this species is critically endangered and has declined drastically throughout the country, due primarily to poaching, illegal hunting and habitat degradation. A 1987 ha reserve was established in 1952 at M'Sabih Talaa [MT] (West central Morocco) to preserve the remnant Northern plain population of this species. This reserve is surrounded by a rural area with a local human population based on rain-fed agriculture and extensive livestock. The threatening extinction of this Gazelle population recently led to implement in-situ conservation measures. This work aimed to: i) assess the population demographic characteristics, ii) analyze the population viability (PVA), and iii) set up an integrated conservation program. The line-transect method was used to estimate the population size and structure. The PVA was carried out with the Vortex software. A participatory approach was used to elaborate an action plan for rural sustainable development and reserve management. The total size of the gazelle population was estimated to 110-120 individuals corresponding to a decline of more than 40% within the last two decades. The sex-ratio was 0.42:0.58. The age class structure was as follows: 69.8 % of adults (42.1% females and 27.7% males) and 30.2 % of young. The average fecundity rate was  $0.72 \pm 0.13$ . The population would not be viable under current circumstances within the next 100 years. The main activities of the action plan are to engage local people in promoting the sustainable regeneration of the rural economy and the pride in their natural environment. The MT reserve will be promoted as a visitor attraction, an environmental awareness centre, and a hub for the sale of high quality local produce. The viability of the MT gazelle population would depend on the partnership for action between local people, protected area managers, gazelle conservationists, and the local government.

**Keywords:** Dorcas gazelle, Population viability, Conservation, Sustainable development, Morocco

**Akala Ben Musonye**, Adano Wario R., Yabann Wilson K.

**Analysis of the effects of ill human health on the Kakamega rainforest ecosystem in Western Kenya**

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Poster session P09, Global environmental change and health

Kenyan forests face serious threats because of land-use conversion and increasing pressure of resource use. A small Kakamega forest, the easternmost limit of the Guineo-Congolian equatorial rainforest is no exception. The forest is a biodiversity-rich unique ecosystem containing several endemic species of wildlife, and supports a large population of predominantly small-scale farmers. High poverty levels, diseases, and rising modern healthcare costs have jointly increased local-level dependence on indigenous trees from the ecosystem for herbal medicines. However, the importance of medicinal plants collection and the impacts of related disturbances in contributing to habitat and biodiversity losses remain a little investigated issue. This paper examines the extent of local demand for forest-based medicinal plants, and considers the effects of ill human health on the Kakamega rainforest ecosystem, Western Kenya. A household survey of communities living within 5-km distance around the forest, several key informant interviews, and secondary literature were used to gather information. The forest ecosystem is evidently the main source of herbal medicines for a majority of forest-adjacent rural households. We find significantly different inverse relationships between visits to modern healthcare facilities and the frequency of herbal medicine use, underscoring the importance of wild plants in rural households' healthcare economy. The use of herbal medicines substantially reduces the health bill of the users as the cost of modern healthcare services soars and becomes ill-affordable to poor Kenyans. Removal of barks and roots of indigenous plants for medicinal preparations and for the treatment of human ailments seriously damages trees and alters the composition and conditions of the forest ecosystem. Understanding the role and effects of harvesting medicinal plants on the natural ecosystems is critical for drawing up conservation priorities, and sensible incentives which balance human and forest ecosystem health.

**Keywords:** Rural population, forest ecosystem, ill human health, Medicinal Plants, Western Kenya

**Albert Cecile**, Thuiller Wilfried, Lavorel Sandra

**Intraspecific functional variability: quantification along environmental gradients and implications in vegetation modelling - An alpine study case**

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Poster session P07, Biodiversity and ecosystem functioning

**Background and goal of study**

In a global change context, understanding how species behave in different conditions seems essential to predict their response to the coming changes and the resulting effects on ecosystem dynamics. Intraspecific functional variability has been traditionally assumed to be negligible in comparison with the interspecific one without a clear quantification. Consequently, species were mainly described by mean traits in functional studies and by unique fixed parameters –and not as functions of the environment- when modelled. Within this study, we: (1) quantify the intra-specific functional variability for a selection of plant species and describe its link with climatic gradients and species environmental requirements (species niche); (2) include and test the effects of functional diversity in landscape modelling.

**Materials and methods**

Providing steep gradients, and assumed to be particularly sensitive to global warming, alpine systems have been chosen as an ideal study system. After designing an appropriate sampling strategy, we sampled a set of functional traits (plant height, leaf dry matter content, leaf nitrogen content...) on 16 common species of the French Alps within a stratified landscape.

**Results and discussion**

The measured variability turned out to be large and mostly due to environmental effects and individual differences. Exploring multivariate traits patterns showed that intraspecific variability does not modify species strategy definition but that intraspecific variability was not necessarily negligible. We then managed to summarise the idiosyncratic links between traits and gradients showing a strong link between traits and species niche, estimated by habitat suitability models. Finally we also tested the introduction of functional intraspecific variability into a landscape model (LAMOS) and showed a strong sensitivity of it.

**Keywords:** intraspecific variability, leaf traits, alpine systems, environmental gradients, landscape modelling

**Amoroso Victor****Plant diversity and status in two mountain ecosystems in the Southern Philippines**

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Poster session P17, Monitoring biodiversity

**Background and goal of study**

Biodiversity loss in Philippine mountain ecosystems is alarming due to forest destruction, and few studies were done on plant diversity. This research was conducted to determine the vegetation types, the richness and the status of plants in two protected areas in the Southern Philippines as bases for protection and policy formulation by the Protected Area Management Board (PAMB).

**Materials and Methods**

Transect walk and nested sampling plots of 20 x 20 m were employed in determining the vegetation types and diversity indices. An assessment of the species status was adopted from IUCN and the National List of Threatened Plants.

**Results and Discussion**

Mt. Malindang had eight vegetation types while Mt. Hamiguitan had four types. Each vegetation type is characterized by a specific combination of plant species. The inventory of plants in the forest ecosystems of Mt. Malindang showed a total of 1,284 species while Mt. Hamiguitan revealed 878 species. The former had 56 threatened species, 138 endemic species and 289 species of economic value, while the latter had 34 threatened, 163 endemic, and 204 economically important species. In both mountain ecosystems, the montane forest exhibited high species richness and endemism, and high diversity values. It is expected that the species diversity index may increase when the forest will be protected and properly managed by the local people inhabiting the parks.

**Conclusion**

Mt. Malindang had more vegetation types than Mt. Hamiguitan. Moreover, being a forest in ultramafic soil, Mt. Hamiguitan had a low species richness but with high endemism than Mt. Malindang. In both mountains, threatened species were high, due to land conversion and resource utilization and therefore these areas should be given high priority for protection and conservation.

**Keywords:** vegetation types, richness, assessment, plants, protected areas

**Anjanappa Kavitha****Distribution of trees and carbon sequestration in a rain-fed agro biodiversity. A case study from Karnataka, South India**

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Poster session p11, Conservation, conflicts resolution and development

Various species of trees are incorporated in various ways in farming systems under rainfed semi-arid agro-ecosystems in India. The choice of trees and where they are grown are influenced by both ecological and socioeconomic factors. However, it is dominated by the goal of sustaining basic livelihoods. This study aims at assessing the tree resources of three villages in the Kanakapura region of Karnataka, South India. Trees were identified and recorded to assess the on-farm tree richness, diversity, density and biomass. A socio-economic assessment of farmers in relation to the kind of trees they maintain on their farms, reveal interesting reasons for growing trees. A total of 1285 individuals belonging to 72 tree species were recorded in homestead gardens, agricultural bunds, stream, tank bunds, and in the avenues of the these villages. The dominant species among these villages were *Melia dubia*, *Eucalyptus torticorni*, *Thespesia papulenea*, *Pongamia pinnata*, *Wrightia tinctoria*, *Tamarindus indica*, *Artocarpus integrifolia*, *Albizia amara*, *Ficus benghalensis* and *Cocos nucifera*. Among the ten top species eight are local and two are exotic. *Eucalyptus* has been observed as the top dominant exotic in the region because of its promotion during 1980 under social forestry programme. The *Aeagle mermeolous*, one of the threatened species, and few keystone species were also recorded in the region. The use patterns of trees were related to socio-economic characteristics such as occupation, land size, food habits, extension contacts, education status, and protective functions. High species diversity and biomass in non-forest land categories in the study area indicates their potential for the promotion of species diversity and the inclusion of these species in local afforestation programs to enhance the native biodiversity and carbon sinks as suggested.

**Keywords:** agro-ecosystems, biodiversity, richness, threatened species, carbon sinks

**Aronowsky Audrey**, Mark Westneat, Cranston Karen

**How synthesis meetings can accelerate biodiversity science: workshops and tool development for the Encyclopedia of Life**

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Poster session P08, Conservation planning

**Background**

Biodiversity informatics is changing the speed of problem solving and also the kinds of hypotheses that are testable in a wide range of biological disciplines. The Encyclopedia of Life (EOL), an open-access clearinghouse for information and content on biodiversity, aims to promote linking and interoperability of diverse datasets to accelerate biodiversity science. EOL hopes to achieve these goals by funding workshops to foster international cooperation and develop new informatics tools.

**Methods**

The EOL Biodiversity Synthesis Center (BioSynC) helps to facilitate scientific discovery in biodiversity, evolution and conservation biology by hosting synthesis meetings for the EOL. These small, focused meetings bring together experts on particular scientific and public issues to encourage progress towards specific goals. Meeting topics are proposed by the international scientific community. Meetings focus on biodiversity informatics involving large data sets, the formulation of novel scientific ideas, and building new bridges among disciplines. In particular, synthesis meetings deal with timely issues in biodiversity or conservation research that have a direct relation to the Encyclopedia of Life or develop new ways of using the growing content of the EOL web-pages for scientific discovery. Of particular interest are megadiverse groups, novel research questions in biogeography, evolution, systematics, and taxonomy, the visualization of large data sets, and the study of biodiversity hotspots.

**Discussion**

Here we present the highlights of our first two years of synthesis meetings, including new applications for compiling plant phylogenies and a general tool for the visualization of large systematics data sets.

**Keywords:** biodiversity, informatics, open access, evolution, tool development

**Ayuke Fredrick**, B. Vanlauwe, M.M. Pulleman

**Earthworm and termite diversity in agricultural soils across agroecological zones of sub-Saharan Africa and their relation with stable soil aggregation**

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Poster session P07, Biodiversity and ecosystem functioning

**Background and goal of study**

Soil invertebrate fauna, in particular termites and earthworms, play an important role in the decomposition of organic residues and soil structure formation and therefore affect soil quality for crop production. Little is known about their diversity in agricultural soils across different climate and soil conditions in Sub-Saharan Africa (SSA) and their importance for stable soil aggregation. We investigated termite and earthworm diversity in 12 long-term agronomic field trials in SSA and determined to what extent soil macrofauna and soil parameters (Soil organic matter (SOM) and soil texture) explain the variation in stable macroaggregation in soils under long-term fallow and arable cropping.

**Materials and methods**

Soil samples of long-term arable and fallow were obtained across 12 long-term agronomic experiments in East and West Africa. These were analyzed for general soil parameters, termite and earthworm abundance and biomass and stable aggregate size distribution by wet-sieving.

**Results and discussion**

Soil fauna diversity and abundance, SOM and stable macroaggregation were generally higher in the fallow compared to the arable systems. Taxonomic abundance and distribution of the two faunal groups correlated with soil texture, SOM, altitude, rainfall and temperature, which in turn correlated with longitude and latitude. Significant multi-collinearity was found among soil fauna diversity, soil parameters

and soil aggregation. Under fallow, 53% and 33% of the total sample variation in stable soil aggregation was related to macrofauna activity and soil parameters (SOM and texture) respectively. Under an arable system, 36% of the total sample variation was related to macrofauna activity, while 52% was related to SOM and soil texture.

### Conclusion

Arable cropping negatively affected termite and earthworm diversity and abundance compared to long-term fallow. Macrofauna activity is an important driver of stable macroaggregation. However, the beneficial role of soil fauna is reduced with increasing soil disturbance due to long-term crop production as compared to fallow systems.

**Keywords:** Soil macrofauna diversity, aggregate stability, fallow, arable cropping, Sub-Saharan Africa

### **Balian Estelle**, Pelegrin Flora, Nilsson Thomas, Buiatti Marcello, Lawson Gerry

#### **Find funds for biodiversity research in Europe: a BiodivERsA webportal to European funding programmes and agencies**

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Poster session P20, National DIVERSITAS Committees and National Programmes

Biodiversa is an ERA-net (European Research Area) project where 19 European research funding agencies seek best practice as a basis for cooperation in order to strengthen European research in Biodiversity. This project aims at setting up an efficient trans-national co-operation in the field of biodiversity research funding. Also, contributing to the EU Biodiversity Strategy, BiodivERsA allows European funding agencies to collate existing activities, compare future strategies and recommendations of consultative bodies, and systematically explore opportunities for future collaboration. One of the key products developed by BiodivERsA is a Research Information System that compiles information on European, national, and regional funding programmes and funding organisations, supporting biodiversity research in order to provide:

- 1 a webportal on current and past funding programs in Europe, open to biodiversity researchers, including thematic and non-thematic programs, grants, fellowships, and studentships. These funding sources can be open to individuals, research organisations or networks of organisations.
- 2 a tool for analysing current funding trends in the field of biodiversity, and for defining future priority research areas for European funding agencies.

The BiodivERsA database has been launched in 2007 with information on BiodivERsA member agencies and since then has extended to other funding organizations in Europe. It is continuously looking for additional funding agencies to participate in this platform, especially in European countries, which are not currently represented in BiodivERsA.

**Keywords:** research funding, European, ERA-NET, database, networking

### **Baptiste Brigitte Luis Guillermo**, Lorena Franco, Pedro Quijano, Juan David Amaya, Ana Milena Piñeros, Luis Guillermo Castro, Leonardo Andres Ariza, Alma Ariza, y German I. Andrade

#### **Resilience thinking and biodiversity policy making. The Colombian case**

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Poster session P02

Following the incorporation of the Convention of Biological Diversity CBD to the Colombian legal system, the country expanded the biodiversity information base; accomplished a ca. two - fold increase in protected area expanse and developed an important bio-trade initiative, among other achievements. Notwithstanding, currently society faces up unexpected challenges to avoid further biodiversity losses and to integrate it into the dynamics of an expanding national economy. Conscious of this, the vice Ministry of the Environment, called upon the Javeriana University, in order to carry out a technical exercise in order to update the biodiversity policy, especially taking into account conceptual and technical developments which have occurred within the CBD. The results include: i) a conceptual framework for biodiversity management, based upon the resilience thinking paradigm applied to socio-ecological systems; ii) A model that accounts for the various stability domains in which natural and social systems appear in the territory; iii) A revision of the state - pressure - response model, in order to include new drivers of change and to devise a hierarchical cross scale interactions affecting biodiversity; iv) An update version of the biodiversity stakeholders - scenario in the country; and v) a general prospective exercise for the next 10 years. The outcomes of the exercise are now being used for systematic country-side consultations. The concepts of socio-ecological systems and biodiversity management have showed potential for consensus building, in a new area of conservation agreements, which will include actions around political conservation and development explicit tradeoffs.

**Keywords :** resilience, socio ecological systems, biodiversity, policy, conservation

**Barbosa Eduardo**, Van Langevelde Frank, Tomlinson Kyle, Kevin Kirkman, De Bie Steven, Prins Herbert H.T.

**Savanna trees versus grasses: competition in early seedling recruitment**

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Poster session P08, Conservation planning

**Background and goal of study**

Seedling establishment is a critical stage in the life history of plants, shaping population structure and community composition. However, there is still little information on the relative importance of two important strategies: competitive inhibition; and resource limitation for seedling growth. Understanding tree-grass interactions in savannahs assemblages may have important consequences for the management of those savannahs.

This study aims to evaluate the effect of important abiotic factors (water; nutrients, sunlight exposure) and biotic (herbivory and grass abundance) on seed germination; seedling establishment, and plant recruitment of savannah trees and grasses.

**Materials and methods**

Seedlings of eight savannahs species were planted into 4 m<sup>2</sup> treatment sub-plots consisting of different combinations of water, nutrient (N and P), light and grass in a factorial design. The shade component will help to assess the potential of microhabitat facilitation by parental trees.

**Results and discussion**

Preliminary results show that, as expected, different species have different requirements. Shade had a strong effect on the germination of Mimosoideae species, which may be due to the fact that shade helps maintaining soil moisture levels high. Conversely, none of the treatments showed a major effect on Caesalpinioideae species. The effect of competition with grass in tree development was more evident in treatments with no shade. The shade appears to suppress the grass development, minimizing negative effects on tree seedlings.

**Conclusion**

Research into tree seedling growth could help to resolve whether the recruitment bottleneck is mediated by disturbance and resource availability alone, or whether competition with the grass layer further limits the recruitment. Seedling growth comparative studies of different savannah tree species would tell us how species have adapted to local resource conditions and whether these adaptations have affected their ability to grow in competition with grasses.

**Keywords:** Savannahs, community composition, tree seedling establishment, tree-grass interaction, bush encroachment

**Barnaud Adeline**, Mcgeoch Melodie, Van Vuuren Bettine

**Weed dynamics: Evidence from the spatial genetic structure of *Raphanus raphanistrum***

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Poster session P03, Agrobiodiversity

Agricultural weeds are a major cost to the economy worldwide. Knowledge of the likelihood and speed at which gene dispersal occurs in weedy plants is of particular importance for management practices. Furthermore, weedy species constitute good model organisms as they offer examples of evolutionary and ecological change over relatively short time intervals. *Raphanus raphanistrum* is arguably one of the more difficult weedy species to manage and has a cosmopolitan distribution. The Fynbos biome in South Africa is recognized as a Biodiversity hotspot because of high levels of species endemism. We have chosen this biome to investigate the impact that various habitats have on, as well as the evolutionary processes that drive, range expansion in *Raphanus raphanistrum*. We collected leaves from 595 plants from 14 different sites in the Fynbos. We assessed the pattern of genetic diversity using 12 nuclear microsatellites and the trnL-rpl32 intergenic region of the chloroplast DNA. In this study we focus on (1) the phylogeographic patterns of *R. raphanistrum* (2) the spatial genetic structure at different geographic scales and (3) the effect of landscape and environmental features on the spatial genetic patterns.

**Keywords:** *Raphanus raphanistrum*, Brassicaceae, spatial genetic structure, geographical information systems, microsatellites

**Barrios Edmundo**, Coutinho Heitor

**The role of biological indicators of soil quality in the participatory development of land quality monitoring systems**

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Poster session P17, Monitoring biodiversity

**Background and goals of study**

The majority of ecosystem processes have the soil as the critical and dynamic regulatory center and soil organisms contribute to a wide range of ecosystem services that are essential to the sustainable function of natural and managed ecosystems. Our goal is to develop soil quality monitoring systems that inform decision makers at all levels about the ecosystem service provision status of different land use and management options.

**Materials and methods**

This continuing South-South collaboration effort between Latin America and Africa, now with a focus in the Pantanal and Amazon regions of Brazil, is part of a collaborative project between Embrapa and CIAT with financial support from Embrapa and CNPq. Participatory methodologies used to develop a "hybrid" knowledge base, combining local and scientific knowledge, reflect an effort to understand the complexity of land management decision-making to promote and protect multifunctional land uses

**Results and discussion**

Increased concern about soil management as a key determinant of sustainability in agricultural landscapes demands the identification of early warning indicators to monitor changes in soil quality, and their linkage to the provision of ecosystem services. Native plants and soil macrofauna were consistently used by local land managers as biological indicators of soil quality. Modification in plant communities as a result of changes in land use and agricultural systems can have profound impacts on biologically mediated soil processes and thus ecosystem services. This interaction is explored at the landscape scale as part of evolving land quality monitoring systems

**Conclusion**

Participatory development of land quality monitoring systems to evaluate ecosystem service provision performance will allow rural communities, environmental/agricultural institutions and local governments to prepare for negotiations associated with emerging schemes and markets of payment for ecosystem services.

**Keywords:** Indicators, Monitoring, Soil, Participatory, Brazil

**Baudron Frédéric**, Corbeels Marc, Giller Ken E.

**Drivers of land use change in Mbire District, Mid Zambezi Valley: alleviating constraints, expanding opportunities**

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Poster session P05, Drivers of biodiversity

The Mid-Zambezi Valley is a conservation area of global importance hosting large populations of the emblematic mega-fauna of Africa. Agriculturally, it represents a marginal area of Zimbabwe. People and wildlife coexist in a mosaic of fields and natural vegetation. Rapid land use changes occurred after independence. We quantify here these changes and analyse their major drivers, using a combination of methods ranging from interpretation of satellite images to interviews with farmers. Between 1993 and 2001, agricultural land increased by 263% in Ward 2, from 22.2 to 80.5 km<sup>2</sup>, and by 158% in Ward 3, from 53.2 to 137.0 km<sup>2</sup>, whilst the cattle population of Dande Communal Land increased by 151%, from 8,447 to an estimated 21,226 heads. Immigration, both planned and spontaneous, is an important factor that explains these changes, as the population of Dande almost doubled, from 36,074 to 18,362 inhabitants between 1992 and 2002. However, agricultural land expanded faster than human population, implying a change in farming practices in addition to demographic growth. Tsetse control is commonly believed to have been the most important driver, leading to the creation of a "pioneer front". However, the relative annual rate of expansion of agricultural land has been slightly faster in Ward 2 (0.10 km<sup>2</sup>.year<sup>-1</sup>), a tsetse infested area than in Ward 3 (0.09 km<sup>2</sup>.year<sup>-1</sup>), a tsetse free area. We demonstrate the pivotal role of cotton farming in explaining the rapid expansion of agricultural land and accumulation of livestock. This expansion, and the corresponding loss of wildlife habitat, did not slow down after the introduction of the Communal Area Management Programme For Indigenous Resources (CAMPFIRE). This calls for a re-examination of the concepts and approaches of Community-Based Natural Resource Management (CBNRM) programmes, for the conservation of wildlife outside of protected areas to be feasible in developing countries.

**Keywords:** Zimbabwe, CAMPFIRE, migration, tsetse fly, cotton

**Bele Mkou Youssoufa**, Focho Derek Afa, Egbe Enow, Chuyong Gerorge Bindeh  
**Inventory and distribution of the Annonaceae of Mount Cameroon**

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Poster session P13, Analysing patterns and trends

This inventory was carried out on Mount Cameroon in the South West Region of Cameroon. The work was focused on producing an inventory and determining the distribution of the family Annonaceae on this mountain. The study was necessitated by the lack of information on the distribution of the family in the region. It is one of the most used families of flowering plants in the region.

The Complete Census Method was used for the inventory. Twelve sites were investigated. They were located at three altitudinal ranges: Low, Mid, and High. At each site, 8 transects of 500 m x 10m were sampled. Enumeration was then done on 40 transects at low altitude, 40 transects at mid altitude, and 16 transects at high altitude.

A total of 41 species in 20 genera were collected and identified. The number of species decreased with increasing altitude from 32, 27, to 1 species for the low, mid, and high ranges, respectively. The total species abundances were 494, 2035, and 2 for the low, mid, and high ranges, respectively. The low altitudinal range showed a higher species diversity ( $H' = 2.65$ ) than the mid altitudinal range ( $H' = 0.48$ ). The high altitude range with two individuals in a single species was the least diverse ( $H' = 0.15$ ). The species were more even in their abundance distribution within the low altitudinal range ( $J = 0.76$ ) than in the mid altitudinal range ( $J = 0.15$ ). The Mann-Whitney test (w-test) indicated that there were no statistically significant differences between the low and the mid altitudinal ranges at the 95% confidence interval. Thirteen species in 9 genera were restricted to the low altitudinal range, while 8 species in 8 genera were confined to the mid altitudinal range. Only one species was found restricted at the high altitudinal range.

Size of protected areas should be increased at mid to high altitude of the Mount Cameroon to grant further protection in zones with the fewest plant species number and probably with the highest density of endemics.

**Keywords:** Inventory, Distribution, Annonaceae, Mount Cameroon, Cameroon

Beterams Manuel, Bhaskar Radika, Mora Francisco, **Balvanera Patricia**  
**Biodiversity and multiple functions in a tropical dry forest ecosystem**

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Poster session P07, Biodiversity and ecosystem functioning

**Background and goal of study**

How many species are needed to maintain ecosystem functions of highly diverse tropical forests? The focus on a single ecosystem function is likely to support the conservation of only a small fraction of such biodiversity; focusing on a wider range of functions is likely to include a larger fraction of such biodiversity. Here we analyze various functions, seasons and successional stages of a tropical dry forest and explore how: (i) the shape of the biodiversity vs. the magnitude of the ecosystem function relationship changes, and how (ii) the number of species needed to reach 90% of functions increases as the various aspects are simultaneously considered.

**Materials and methods**

The study was undertaken at a tropical dry forest in the Pacific Coast of Mexico. We analyzed aboveground carbon storage, aboveground water storage, functional biomass (e.g. above ground biomass with photosynthetically active foliage), and annual leaf litter production. Dry and wet season functional biomass was compared. Four successional stages (early, middle, late and old growth forests) following pasture abandonment were used.

**Results and discussion**

Most important contrasts in the shape of the biodiversity vs. ecosystem function were those between dry and rainy season functional biomass; more species were needed in the case of the rainy season. Comparisons among successional stages showed an increasing magnitude of the function and an increasing proportion of species needed to reach 90% of the function with increasing age. The number of species contributing to 90% of all the functions, seasons, and stages increased when all aspects were considered.

**Conclusion**

We conclude that a multifunctionality approach is needed to understand the contribution of species diversity to the wide diversity of functions of tropical forests.

**Keywords:** tropical forests, multiple functions, ecosystem function, primary productivity, carbon storage

**Bezerra Joana****Terra Preta and development in the Brazilian Amazon**

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Poster session P11, Conservation, conflicts resolution and development

Besides its biological properties, terra preta has shown to be extremely important, not only because of its impact on the knowledge about past demographic occupation in the Amazon, and the redefinition of its history, but also because of its crucial relevance to present conditions and future possibilities of sustainable development in the region. Studies on terra preta have changed the long lasting view of the Amazon as a "counterfeit paradise", and have favoured bio-cultural and political approaches to the human-environment interaction in the region.

The ideas, assumptions, and prejudices elaborated in recent years about the Amazon - both in the national and international environmental arenas - have been highly complex, sometimes contradictory, and almost always polemic. There is an intersecting point between national and international factors in the definition of the challenges and obstacles in the political, economic, and scientific horizons that refer to the region.

The aim of this paper is to analyze, in three sections, the role of terra preta in the sustainable development paradigm:

1. A brief overview of the history of the knowledge about terra preta: its 'discovery', around 1880, when its anthropogenic quality was put forward, the next hundred years when this quality was highly contested, and its "rediscovery" by 1980.
2. An analysis of the role played by environment in the international scenario, from the beginning of the international environment agenda, around the 1960s, through the shift that took place in the 1970s, until the present scenario.
3. A discussion on four aspects that help delineate terra preta's role in the sustainability paradigm: quality of life for the population of the region, biodiversity conservation, technology and local knowledge.

**Keywords:** terra preta, Amazon, development, agriculture, Brazil

**Blanchard Fabian, Thebaud Olivier, Masski Hicham, Cury Philippe, Mullon Christian, Doyen Luc**  
**The CHALOUPE program: an integrated assessment of marine biodiversity and fisheries viability in the context of global change**

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Poster session P12, Biodiversity and climate change

**Background and goal of study**

Major changes have been observed in marine ecosystems as well as in fisheries. Ecosystems naturally experience variability but the actual rates of change induce strong consequences for the viability of fisheries. The Chaloupe project funded by the French National Research Agency aimed at strengthening our knowledge of the changes observed during the last decades within marine communities and fisheries systems at a regional scale. The project considered these as two co-evolving sub-systems under the control of climate, markets and governance. The diversity/stability debate suggests that changes in communities may depend on their diversity patterns; moreover, the capacity of fisheries to face changes in resource availability varies according to technical and economic factors. Hence three different systems were chosen to investigate these issues: the continental shelves of the Bay of Biscay, French Guyana, and the up-welling area of Morocco. The project involved researchers in marine ecology, resource economics, and modelling, from several research organisations.

**Materials and methods**

Ecological data sets from scientific trawling surveys, and economic data sets from national fisheries information systems were used for statistical analyses, the development of integrated ecological and economic assessment tools and system modelling.

**Results and discussion**

Results were obtained regarding the characterization of changes within fish communities and hypotheses on the effects of climate change and fishing; identification of changes in the biomass and value structure of landings related to changes in the fish communities and in the economic context of fisheries; the development of integrated tools for the assessment of ecological and economic states of the systems considered, and their viability; a typology of dynamic modelling approaches used in the field, according to their ability to represent the systems under study, and implementing some of these models.

**Keywords:** marine fish communities, fisheries viability, integrated assessment, climate change, system modelling

**Boubacar Abdoukarim**, Thibon Maxime, Babin Didier

**Cross-cutting intelligence on biodiversity and ecosystems services in Africa / Towards a social network for exchanging knowledge and expertise**

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Poster session P18, Managing for ecosystem services

**Background**

In 2005, the MA was the first global assessment tasked with measuring ecosystem services for human well-being worldwide. One project was the Southern Africa Sub-Global assessment (SAfMA), using a multi-scale approach to assess ecosystem services across three different spatial scales. In 2006, an international consultation was launched to assess the need, scope, and options for an IMoSEB. The African consultation provided a set of needs and recommendations for how knowledge could be better harnessed to meet the needs of African Biodiversity stakeholders:

- Develop a spirit of information sharing
- Consider a wiki type system
- Create synergy between possessors of traditional knowledge and scientists
- Promote South–South cooperation..

After the completion of the IMoSEB consultation and the MA Follow-up, UNEP took the lead to set-up an Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). The preliminary Gap Analysis underlined the issue of information services and the coordination for sharing knowledge and experience as ones of its preliminary findings.

An African social network could be seen as one of the means to create and strengthen social ties among African communities, researchers, and policymakers, and contribute to IPBES efforts. Such a social network could also bring real added-value to existing information and expertise, while fostering their dissemination and use in decision-making processes for sustainable development.

**Results and discussion**

This social network on biodiversity and ecosystem, based on Web 2.0 technologies, and characterized by user participation, openness, interconnectivity, and interactivity of web-delivered content will allow envisaging:

- Building up African collective and distributed intelligence
- Using peer-to peer networking
- Fostering dialogue
- Emancipating people and communities
- Creating a forum between information suppliers and producers
- Establishing an E-learning capacity building centre

**Keywords:** Biodiversity, social network, sharing, expertise, synergy

**Bourke David**, Coll John, Sheehy Skeffington Micheline, Gormally Mike, Sweeney John

**Biodiversity and climate change - predicting changes and informing adaptation measures in Ireland**

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Poster session P10, Projecting 21st century biodiversity change

Ireland's biodiversity is currently facing a multitude of threats including land-use change, habitat fragmentation, and the introduction of non-native species. Future conservation strategies will increasingly need to consider the potential impacts of a changing climate, in particular shifts in the ranges of species for a variety of climate change scenarios. Recent observations confirm that the global mean temperature has increased by 0.8 °C, with projections suggesting further temperature increases in Europe of between 1.0–5.5 °C by the end of the 21st century. Here we report on a project exploring how predictive modelling techniques may be used to assess some of the potential impacts of climate change on the spatial distribution of Ireland's vulnerable biodiversity. Central to more precise predictions of these potential range shifts will be an understanding of the ability of species to disperse to a favourable habitat, and quantifying the connectivity between these habitats. Our objective is to make use of nationally available datasets to explore the connectivity between Ireland's designated sites (Natural Heritage Areas, Special Areas of Conservation and Special Protection Areas) and to understand how this may affect the future distribution of species vulnerable to climate change. Not only is there a need to assess what the likely impacts of climate change will be, but it

is also necessary to provide recommendations on adaptation and mitigation measures to policy-makers on how to better manage Ireland's natural resources with a changing climate. The EU Habitats Directive requires that a "favourable" conservation status of vulnerable species and habitats is maintained. We propose to support this process by better integrating our understanding of the predicted impacts of climate change in the context of a fragmented network of designated sites into future conservation strategies.

**Keywords:** bioclimatic modelling, climate change, species range shifts, habitat fragmentation, connectivity, EU Habitats Directive

**Boutros Minnattallah**, Linsenmair K. Eduard

**Towards sustainable use of biodiversity in West Africa - Capacity building and conservation, two sides of the same medal?**

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Poster session P08, Conservation planning

Large parts of West Africa are hot spot regions of global biodiversity. Natural resources are highly exploited by men: cash crop and subsistence farming leads to large scale land conversion, medicinal plants, fish, game and alike are overharvested, extremely destructive mining takes place even in protected areas. High demographic pressure, together with the effects of climate change, are main drivers and lead to massive degradations of biodiversity. Poverty and illiteracy are aggravating the problem, as the involved countries (BF, BJ and CI) belong, according to the latest UN-Human Development Report, to the 15 poorest of the world. Since 2001, BIOTA West Africa (funded by the German Ministry of Education and Research, BMBF) develops methods and tools for a more sustainable use and the conservation of biodiversity. In a transdisciplinary and participatory approach and on the basis of sound data collected by more than 100 involved researchers, management recommendations for the local stakeholders have been formulated; products and tools for decision makers have been developed from the gathered results, specifically adapted for the African partner countries. In the framework of BIOTA West Africa and through our close cooperation with the African partners we figured out, that eventually the most important - but generally in cooperative research projects in developing countries highly underestimated and underfinanced - aspect is capacity building. Training of young scientists from all involved disciplines, the close cooperation and scientific exchange with the researchers of the local universities and an infrastructural support for the involved African institutions is the long term guarantee for the success and implementation of a conservation project like BIOTA West Africa. The talk will give an overview of nine successful years of transdisciplinary research and pin point some case studies of capacity building which lead to a long term implementation of conservation goals.

**Keywords:** West Africa, biodiversity, conservation, capacity building, BIOTA West Africa

Bulling Mark, Hicks Natalie, Paterson Dave, Raffaelli Dave, Piran White, Solan Martin,

**Jasmin Godbold**

**Marine biodiversity-ecosystem processes under uncertain and fluctuating environmental futures**

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Poster session P10, Projecting 21st century biodiversity change

#### **Background and goal of study**

The biological composition and richness of most of the Earth's major ecosystems are being dramatically transformed by anthropogenic activity. Marine environments are particularly vulnerable to such changes. Extensive use has been made of experiments involving randomly assembled communities with varying numbers of species to assess the effect of biodiversity loss on ecosystem processes. However, few of these studies have incorporated the extinction driver as an integrated part of the experimental design. Therefore the relationships found between biodiversity loss and the effects on ecosystem processes have lacked real world context. Previous work examined the effect of current and two likely future scenarios of temperature and atmospheric CO<sub>2</sub> levels on the relationships between species richness and ecosystem processes in a benthic marine system. However, some predictions suggest that over large areas there will be an increase in the range of temperature over a 24 hour period. This has the potential to severely alter biodiversity – ecosystem function relationships.

#### **Materials and methods**

Here we extend our previous work by exposing communities of varying richness levels of functionally contrasting macrofaunal species to factorial combinations of mean temperature, amplitude of temperature oscillation and CO<sub>2</sub> levels in a mesocosm experiment. Levels of bioturbation and nutrient flux were measured as ecosystem processes.

**Results and discussion**

We found significant multi-way interactions involving all independent factors driving ecosystem function in the form of nutrient release.

**Conclusion**

Predicting future consequences of climate change on the biodiversity-ecosystem function relationship is likely to be extremely complex.

**Keywords:** Biodiversity, Ecosystem function, climate change, CO<sub>2</sub>, Interactions

**Caesar John Cartey****National scale avoided deforestation: Guyana's Jagdeo ecology policy for biodiversity and society-linked development in the climate change era**

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Poster session P04, Managing biodiversity with a social-ecological system focus

Guyana's experience with possible climate change-induced devastations due to flash floods at frequent intervals over the last decade, in particular, has necessitated a national effort to engage the international community in advancing avoided deforestation as an essential element of any post-Kyoto framework. Guyana's President Bharrat Jagdeo launched what has been dubbed the Jagdeo Climate Change Initiative in September 2007 at the United Nations Conference. The bold initiative is buttressed by recognition of the ecological and economic values of standing forests in the climate change mitigation menu of measures while recognizing the role of tropical forest ecosystems as essential for human well-being. In a local context, Guyana's rainforests provide a plethora of all the ecosystem services that support and sustain the well-being of its citizens and more so its indigenous peoples who are more culturally-dependent on forest biodiversity and related services. The national ecology policy framework for mitigating climate change is rooted in a Constitutional environmental ethos enjoining citizens to care for the environment. Emerging from this national ecology policy advocacy is a government white paper entitled "Creating incentives for avoided deforestation" which fully outlines the framework. Guyana's climate change era ecology policy on avoided deforestation seeks to provide a model economic valuation construct for rewarding developing countries endowed with large pristine rain forests with the requisite economic returns on ecological services provided for climate change mitigation. In so doing local initiatives would ensure sustainable development and the achievement of Millennium Development Goals without overdependence on massive forestry and mining activities detrimental to avoided forestation. The concept engenders other types of sustainable economic development, minimizing deforestation and devolving to the well-being of local communities and indigenous peoples. National capacity needs for effective monitoring and enforcement activities for achieving local avoided deforestation with global ecosystem service benefits can be better resourced.

**Keywords:** avoided deforestation, ecology policy, climate change, human well-being, Millennium Development Goals

**Cayuela Luis, De La Cruz Marcelino, Ruokolainen Kalle****A method to incorporate the effect of taxonomic uncertainty into a correlation between distance matrices**

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Poster session P08, Conservation planning

**Background and goal of study**

The correlation between species compositional distances and distances based on other criteria (e.g. environmental, spatial) is a much-used method in community ecology. There has been, however, little recognition of the errors associated with biological data and the influence that this may have on predictions derived from ecological hypotheses. We present a permutational method that incorporates taxonomic uncertainty into a correlation between distance matrices.

**Materials and methods**

The procedure is based on iterative randomizations that randomly re-assign non identified species in each site to any of the other species found in the remaining sites. The method is implemented in R (<http://cran.r-project.org/web/packages/betaper/index.html>). In addition, simulations on a species dataset were performed to investigate the effects of three variables on the uncertainty range of the predicted Pearson correlation: (1) increasing taxonomic uncertainty; (2) the taxonomic resolution at which morphospecies are determined; and (3) abundance vs. presence-absence data.

**Results and discussion**

An analysis of covariance showed that all these variables significantly influence the uncertainty range of the resulting correlation coef-

ficient. Increasing taxonomic uncertainty expands our uncertainty upon the correlation between community similarity and geographical or environmental distances. On the other hand, ecological redundancy, or similarity in species' responses to environmental factors, reduces the range of distance matrix correlation even if taxonomical uncertainty is strong. The method presented in this study improves the traditional approaches to study the correlation between community similarities and other distance matrices by accounting for some of the uncertainty inherent to biological data (i.e. taxonomic uncertainty).

**Keywords:** Beta diversity, Distance matrix, Floristic similarity, Species assemblages, Sorensen index

### **Celentano Danielle, Sills Erin, Salles Marcio, Veríssimo Adalberto**

#### **Deforestation and Poverty: Evidence of boom-bust development in the Brazilian Amazon**

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Poster session P05, Drivers of biodiversity

The Amazon is the largest remaining tropical forest and protects the world's biggest biodiversity. This region is considered vitally important both for global environmental services and for Brazil's development prospects. The frontier expansion in the Brazilian Amazon is a classic example of the trade-off between environmental conservation and economic development, deforestation is mostly driven by economical activities, especially timber, soybeans. and beef production. However, while 17.7 thousand km<sup>2</sup> have been deforested annually since 1990, poverty remains very severe in the Amazon. In this study, we explored regional patterns in deforestation and poverty, using spatial analyses and multivariate models to test the hypothesis that frontier development has followed a boom-bust pattern. Specifically, we test for a quadratic relationship between cumulative deforestation and extreme poverty rates (individuals with per capita income lower than US\$1/day) in 408 municipalities (3.7 million square kilometers). In multivariate analyses, we include biophysical, demographic, and access factors that have been identified as key constraints and drivers of both deforestation and development. Even after controlling for these factors and for spatial autocorrelation, our analyses consistently and robustly show a boom bust pattern. In terms of monetary poverty, heavily deforested municipalities are no better off than forested municipalities, while they clearly are left with less natural capital. Thus, from a long-run and local perspective, deforestation does not appear to bring any net gain. From a short-run perspective – and certainly from the perspective of agribusiness, ranchers, or the logging industry – deforestation brings an economic boom. Thus, the current paradigm of frontier expansion in the Amazon presents a trade-off between the present and the future as much as between the environment and development.

**Keywords:** Brazilian Amazon, deforestation, poverty, frontier development, boom-bust economies

### **Cerda Claudia, De La Maza Carmen Luz**

#### **Economic valuation of biodiversity and ecosystem services in Chile: State of the art and future challenges**

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Poster session P01, Economics of biodiversity

The economic valuation of ecosystem services provided by biodiversity is highly relevant for a better understanding of how humans benefit from natural systems. However, markets fail to reveal the economic value of many of these services. Stated Preference Techniques (SPTs) use social science surveys to elicit willingness to pay (WTP) for such services. SPTs provide the instruments to quantify economic benefits produced in any biodiversity conservation program. They allow a better understanding of the economic links between people and natural systems and foster participative decision-making processes regarding the use and conservation of biodiversity.

In Chile, however, scientific knowledge about how people benefit from biodiversity and ecosystem services is still scarce. Most research is based on market data. Additionally, most attention is focused on the development of disciplinary ecological models for conservation. Although the Biodiversity National Strategy establishes that the way citizens value their own biodiversity should constitute an important input in designing conservation strategies, research efforts in this direction are scarce.

We argue that SPTs shed light on this issue and may be powerful tools for informing participative decision-making regarding the use and conservation of biodiversity if they are appropriately designed. Based on research carried out in Chile from 1998 to 2009, the purpose of this study is to explore the state of the art with respect to the applicability of SPTs in valuing natural systems from a non-market perspective. The economic valuation of recreation, charismatic species, scenic beauty, and ecosystem services provided by urban ecosystems is shown as WTP. These results would indicate that people are willing to pay for conservation. Future research needs are also identified. As conservation programs in Chile are designed in a way that is suitable for economic valuation, SPTs are useful in complementing such valuation and for the design of conservation strategies that are supported by the public.

**Keywords:** Stated Preferences Techniques, Willingness to pay, Chile, Biodiversity, Ecosystem services

**Chettri Nakul**, Sharma Eklabya**A large-scale conservation planning in the Himalayas**

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Poster session P08, Conservation planning

The drastic anthropogenic loss of habitat in biologically outstanding regions has created biodiversity hotspots like the Himalayas, in which the long-term viability of threatened and endemic species is questionable in the absence of amicable conservation intervention. It is apparent that the conservation of these threatened ecosystems requires implementation at a landscape-scale and maintain sufficient contiguous habitat to support viable population of species and ecological processes. In general, and especially in the densely settled hotspots like the Himalayas, this goal will require cooperation and meaningful participation of local stakeholders and their acceptance of some forms of compromises on land use or land management with stake in planning, implementation and benefit sharing processes. There is nothing more important for the mission of conserving biological diversity than the growing cadre – of several thousand - leaders engaged in conserving functional landscapes. This is possible, when conservation processes integrate ecological issues into so-called social-ecological settings in landscape management. In the past, the conservation literature has devoted extensive attention and sophistication to the problem of where to impose land use restrictions. The problem is framed in optimization terms, for instance, selecting a set of reserve sites that achieve specified environmental goals at minimum cost. Many of the earlier exercises focused narrowly on species representation as a goal, and used crude proxies for cost, such as area. More recently, the set of objectives has expanded to include the resilience or persistence of protected biodiversity, and the maintenance of ecological processes. We bring forward, in this paper, why the ecological dimension currently lags behind in the conservation arena and to what extent people's innovations can enhance the fit among ecological, socio-cultural, and economic systems.

**Keywords:** landscape management, Kangchenjunga complex, participatory planning, decision making, challenges

**Coleman Ross****Know what you want: Monitoring of management targets in ecological restoration for biodiversity**

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Poster session P17, Monitoring biodiversity

The restoration of habitats requires two things. First, a quantitative understanding of existing ecological conditions, and second, a statement of the desired ecological outcomes of the completion of restoration. The long-term management of the Waterbird Refuge (WBR) at the Sydney Olympic Park (NSW, Australia) included increasing the diversity and the number of birds utilising the WBR and so the WBR was drained and tidal flushing increased via a 'SmartGate'. This project evaluated the WBR in respect of wading birds and their food under current conditions. Michael algal abundance was examined using chlorophyll density as a surrogate measure. This was variable between the three locations chosen (two controls and the WBR) but most importantly, was very variable at the scale of 10's of centimetres. Within the WBR, the macrofaunal was examined as an estimate of available food for wading birds. This showed that the total assemblage variation between sites (10's of metres) was less than that at a smaller scale, that of centimetres. The assemblage macrofaunal encountered was very different from controls before the 'SmartGate' was installed. The wading bird assemblage noted as feeding at the WBR were dominated by *Recurvirostra novahollandiae* and *Himantopus himantopus*, however the location of feeding activities did not change. From this three-year study, it is clear that the ecological conditions of the WBR and are now very different post installation of the 'SmartGate'. The assessment however, did not match monitoring goals to management outcomes.

**Keywords:** birds, restoration, drainage, beyond BACI, experiments

**Copa María Eugenia**, Pacheco Luis Fernando**A Bolivian experience of the regional management of forest by source-sink systems**

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Poster session P08, Conservation planning

The indigenous peoples from Beni (living in the tropical forest of Bolivia) requested permission from the government to make trade use of five animal species for leather exportation (*Pecari tajacu*, *Dasyus novemcinctus*, *Hydrochaeris hydrochaeris*, *Eunectes murinus* and *Tupinambis* sp.). The requesting document presented technical problems, which the government decided to solve by giving permission under the condition of compliance with technical advice on Participative Managing. The model base on source-sink systems was applied to Communal Territories (several communities) and required the monitoring of harvesting programs for hunters. The first step in the process was zoning all the Community Territory into zones permitting and not permitting hunting (reserves). From this designation the communities signed an internal regulation agreement, which explained acceptable areas for hunting and not hunting (defined by them) and they

committed them to take a record about the harvest. These "Communal Standards" will be a base of the governmental regulation. The program "5 species" has four territories, and these range in size from 270 - 1686 km<sup>2</sup> and the proportions of land designed as reserves are between 37 and 63%. A further step in this Program is following up about of wildlife population by a hunting reported, as well as an additional study of the population to evaluate effective land use. This monitoring will allow the evaluation of the set proportions of zones for hunting and reserve. The Program will feature direct participation of resident people in managing their lands and reclassifying zones for hunting if necessary.

**Keywords:** Source-sink, hunting, trade, communal, Bolivia

**Costello Mark**, Ward Appeltans, Walter Berendsohn, Anton Guentsch, Louis Boumans, Juliana Kouwenberg and Yde de Jong, Thierry Bourgoïn and David Ouvrard, Michael Guiry, Charles Hussey and Roger Hyam, Nihat Aktac, Henrik Enghoff, Alessandro Minelli, Werner Greuter

**Development of taxonomically authoritative online species databases in Europe**

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Poster session P17, Monitoring biodiversity

Several expert-edited species databases have emerged in Europe: both regional (Fauna Europaea, Euro+Med PlantBase, European Register of Marine Species), and global (AlgaeBase, World Register of Marine Species, Species 2000 and its component Global Species Databases). However, the content, supporting technical infrastructure, governance and management, and plans for their long-term sustainability vary significantly. We outline how these weaknesses are being addressed.

The Pan-European Species-directories Infrastructure (PESI) ([www.eu-nomen.eu/pesi](http://www.eu-nomen.eu/pesi)) project will enhance the regional databases content and technical infrastructure to make them more compatible in terms of content, and enable data integration, and mirror sites. PESI is funded by the European Union 'FP7 Research Infrastructures' from May 2008 for 3 years, and involves 40 organisations from 26 countries. It builds on the research networks EDIT and MarBEF, and supports EU contributions to the Global Biodiversity Information Facility.

A network of experts in species taxonomy, identification and ecology is being built across Europe and will include the Palaearctic. They will quality control national species inventories and other data. Long-term governance of the databases is being pursued through the scientific Society for the Management of Electronic Biodiversity Data. The common data-portal will service a wider range of users than the present resources, and provide the first synonymised checklist of all species in Europe including flagging those of conservation importance. In collaboration with the expert network and users, this will develop additional data services for end-users, such as tools to quality check species names, and the interoperability with scientific publications (journals, abstracting databases). The approaches described here will be utilised to provide long-term sustainability for other expert networks and technical infrastructures.

**Keywords:** biodiversity informatics, information systems, inventories, fauna and flora, land and aquatic

**Crosmary William-George**, Fritz Hervé

**Does the risk of encountering hunters influence African herbivore behaviour at waterholes?**

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Poster session P05, Drivers of biodiversity

**Context and goals**

Human activities, such as sport hunting, are to be considered in the general framework of predator-prey relationships studies. In areas where sport hunting is practised, preys may have not only to deal with their natural predators, but also with human pressure. Understanding the way preys adjust their behaviour in response to this additional source of predation risk is of crucial interest for the management of the prey populations. Here we wanted to investigate whether African herbivores would adjust their behaviour at waterholes in response to the risk of being shot by sport hunters. Particularly, we wanted to test whether the preys would shift their temporal use of waterholes from daylight hours to night hours in order to avoid the risk of encountering hunters.

**Methods**

In Hwange National Park (HNP), Zimbabwe, we monitored waterholes to record the temporal niche of three African trophy ungulates (impala, kudu, and sable). We also monitored waterholes in several Hunting Units (HU) in the vicinity of HNP. We thus disposed of a contrasting situation between HNP with no sport hunting, and its peripheral HU where sport hunting is practised.

**Results and discussion**

In HNP, all species showed avoidance of waterholes at night hours, the period when the risk of natural predation is highest. Conversely in HU, all species visited waterholes more often at night than within HNP. Our results suggest that, for the three studied herbivores, the waterhole use significantly shifts from daylight hours towards night hours in areas where sport hunting occurs. This study is a clear example of how species preyed by natural predators readjust their anti-predator behaviour in response to the additional risk of predation imposed by humans. It therefore implies that the "natural" trade-offs associated with predators in these areas are being changed by the addition of hunting. The consequences for the fitness of individuals and overall population need to be investigated.

**Keywords:** Sport hunting, Predation risk, Landscape of fear, Temporal niche, Hwange National Park

**Cunha Carina**, Torralva Mar, Doadrio Ignacio, Oliva-Paterna Francisco J.

**New insights into *Aphanius iberus* conservation genetics**

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Poster session P19, Systematics and taxonomy

**Background and goals**

The maintenance of genetic diversity and population distinctiveness are two major goals in conservation management plans of endangered species. *Aphanius iberus* is a cyprinodontidae and is one of the most endangered freshwater fishes in Europe. The main threats to *A. iberus* subsistence are human activities, especially, the destruction of habitats, water pollution, and the introduction of exotic species, which appears to have displaced *A. iberus* from its habitat. The aim of this work was to characterize and compare the genetic variability within and among populations of *A. iberus* across its entire distribution area, which allowed gathering information for an efficient genetic management and the establishment of a reproduction plan in order to attain the total recovery of *A. iberus* populations.

**Material and methods**

To achieve the goals established in this study, 19 microsatellite primers were tested, 8 isolated from *Aphanius fasciatus* and 11 from *Cyprinodon* sp. The genetic parameters that allowed to characterize the genetic diversity of the populations, and helped to evaluate their genetic condition were examined through standard software.

**Results & discussion**

Eight out of 19 microsatellite loci were used to describe the genetic diversity parameters. *Aphanius iberus* showed low levels of genetic diversity being extremely threatened. The results indicated that the populations of the Minor Sea behave as a metapopulation that allows them to have gene flow despite not being always bidirectional. For more effective conservation we propose nine conservation operational units.

**Conclusion**

All genetic parameters such as genetic variability, allelic richness, etc, for each population allowed us to know their genetic pool and to prioritize the conservation actions. Taking into account all data that were gathered in this study it was possible to recommend which population source must be used in captive breeding for the restocking program.

**Keywords:** cyprinodontiform, microsatellites, conservation, gene flow, management

**Cunha Carina**, Doadrio Ignacio, Coelho Maria Manuela

**Tetraploidization after intermediate processes of non-sexual reproduction as a process of increasing biodiversity**

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Poster session P06, Biological diversification

**Background and goals**

Often we stumble upon discussions of the importance of hybridization and polyploidization as a key mechanism of diversification, producing new evolutionary lineages and thus contributing to increased biodiversity. Through these processes, most animals reproduce by non-sexual modes, resulting in abnormal sex ratios. To complete the speciation process, pre or post zygotic isolation must occur. The enigma about the role of tetraploidization as an evolutionary step in non-sexual species complexes persists because of a lack of supportive examples in nature. The Iberian freshwater fish *Squalius alburnoides* complex represents one such example.

**Material and methods**

To reveal the particular features of reproduction and gametogenesis, experimental crosses, ploidy level and sex determination were performed. Seven microsatellite loci were used to discriminate the genotypes. The genetic diversity parameters were estimated through standard software.

**Results and discussion**

Previous studies showed that *S. alburnoides* populations are mainly composed of triploid and diploid hybrid forms, and that tetraploid forms are rare or absent. Two populations revealed, however, a distinct scenario: tetraploid individuals represented 85.6–97.5% of the population, without sex ratio bias. Based on flow cytometry measurements of blood and spermatozoa cells, microsatellite loci and experimental crosses, we described, for the first time, two symmetric allotetraploid populations that resumed normal meiosis after undergoing intermediate processes of non-sexual reproduction to give rise to a new sexually reproducing polyploid species as a consequence of their evolution isolated from the other forms, via prezygotic and possibly postzygotic mechanisms.

**Conclusion**

This extraordinary example illustrates how hybrid polyploid complexes can give rise to new sexually reproducing polyploid species highlighting their importance as a biodiversity mechanism, especially among the lower vertebrates.

**Keywords:** polyploid speciation, hybridization, non-sexual reproduction, microsatellites, tetraploidization

**Dammert Bello Juan Luis****Hydrocarbons in Natural Protected Areas: decision making process in Sierra del Divisor Reserved Zone, Peru**

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Poster session P02, Biodiversity science and policy

**Background and goal of study**

The “Sierra del Divisor” Reserved Zone, a natural protected area located on the Peruvian border with Brazil, superimposed on an indigenous Territorial Reserve and recently on an hydrocarbons block and also mining concessions, faces a dilemma between different visions of conservation and development. In the area, the interests of indigenous and conservation organizations; oil, mining and timber companies; infrastructure projects; and local non-indigenous settlers come together. The negotiation between these interests occurs not only between the representatives of civil society, but also within the state between the different Ministries involved, such as Mining and Energy, Environment, Agriculture, Foreign Affairs, and Communications.

According to the Peruvian legal frame, it is by means of categorization processes that the category (and therefore, what can and can't be done in the area) of the reserved zones are defined. In the case of Sierra del Divisor, this process began in April of 2006, and at the moment it is not known which will be the final result of the categorization and its extension. However, there is a lot of fear from conservation and indigenous organizations that the categorization process will be ignored and the pressure of extractive industries, particularly oil companies, will prevail in the final result.

The goal of this study is to analyze the shortcomings of the science-based defense of Natural Protected Areas and participatory processes in decision making when explicit power issues are involved.

**Materials and methods**

Analysis and systematization of relevant documents and maps; interviews with relevant actors.

**Results and discussion**

Discuss the role of science-based findings in policy making in developing countries.

**Conclusion**

Decision making processes regarding biodiversity are framed by social, economic and political issues that should be acknowledged.

**Keywords:** conservation, hydrocarbons, decision-making, power, Peru

**Davault Dominique**, Golléty Claire, Broudin Caroline, Michel Renaud, Migné Aline

**Role of the canopy in the diversity and the functioning of the *Fucus serratus* zone**

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Poster session P07, Biodiversity and ecosystem functioning

**Goal of study**

Canopy-forming algae are considered important in structuring rocky shores. A canopy is often constituted of a single species that (1) dominates the algal biomass, (2) protects other algae from desiccation and photoinhibition and (3) increases the heterogeneity of the habitat and the amount of organic matter available for the local food web. It is subject to local and global disturbances: some species are harvested and the weather variability induced by global change can affect the canopy cover.

**Methods**

In order to understand the consequences of canopy disappearance, both on the biodiversity and on the functioning (primary production and respiration of the community), we tested the effect of the *Fucus serratus* canopy removal by comparing 5 fixed manipulated quadrats (30x30 cm) to 5 fixed control quadrats. From February 2006 to August 2007, algal and animal species richness, algal cover and animal density were monitored every season. Functioning was assessed by measuring the CO<sub>2</sub> fluxes at the rock-air interface using a benthic chamber. Canopy removal was maintained all along the experiment.

**Results**

During the entire survey, no other alga replaced the canopy. Despite an important variability, both gross primary production and respiration remained dramatically lower on manipulated quadrats than on control ones. Canopy removal also decreased significantly animal species richness and density, particularly those of gastropods. It had no significant effect on algal species richness. At the end of the experiment, the biomass (dry weight) was significantly higher on the control than on the treatment, for both algae and animals, but the understorey algal biomass of the control (i.e. biomass calculated without *F. serratus*) was not significantly different from the algal biomass of the treatment.

The functional and the identity roles of the canopy are discussed and compared to results obtained with the same methods on a neighbouring canopy (*Ascophyllum nodosum*).

**Keywords:** Diversity, Functioning, Intertidal, Canopy, Rocky shore

**Denich Manfred**, Gole Tadesse Woldemariam, Gatzweiler Franz, Senbeta Feyera W.

**Conservation and use of the wild populations of *coffea arabica* in the montane rainforests of Ethiopia:**

**From research to action**

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Poster session P03, Agrobiodiversity

**Background**

*Coffea arabica* originates from Southwest Ethiopia, where its wild populations naturally occur in the understory of the montane rainforests at altitudes between 1,000 and 2,100 m. Wild Arabica coffee is not only consumed by local people, but it is also a cash crop for the local as well as the international specialty market. Above all, it is a unique gene pool for national and international coffee breeding, due to its high genetic diversity. As forest land is increasingly converted to agricultural land, the wild coffee populations and their habitat, the montane rainforest, are highly threatened.

**Methods**

Science-based conservation and use concepts require inter and transdisciplinary research, integrating natural sciences, economics and social sciences. In this context, we carried out vegetation studies, forest mapping, molecular genetic analyses, phytopathological and ecophysiological surveys, quality screening, an economic valuation of the forest and the coffee gene pool as well as institutional analyses.

**Results**

To bridge the gap between research and practice, an NGO, the Ethiopian Coffee Forest Forum (ECFF), was founded. Based on the research findings, ECFF and its German partners work on (1) the establishment of a protected area for wild coffee and its forest habitat, (2) the development of guidelines for the use of wild coffee and the coffee forests, (3) the establishment of in-situ gene banks for the conservation of wild coffee genetic resources, and (4) concepts for environmental and conservation education and public awareness raising.

**Conclusion**

As the wild coffee populations and the montane rainforests are important for both biodiversity conservation and the livelihood of people, we concluded that the UNESCO-MAB biosphere reserve approach is the most suitable option to combine nature conservation and human development. The way from basic research to implementation-oriented and participatory activities will be described and discussed.

**Keywords:** transdisciplinarity, natural sciences, socioeconomics, NGO, biosphere reserve

**Desgranges Jean-Luc****Knowing, mapping and understanding St. Lawrence's biodiversity**

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Poster session P17, Monitoring biodiversity

**Background and goal of study**

Environment Canada and the Québec Department of the Environment, partners in the St Lawrence Vision 2000 Action Plan, set out to prepare a compendium of knowledge of the flora and fauna of the St Lawrence and to identify potential conservation sites. The resulting portrait is an Internet site (<http://www.qc.ec.gc.ca/faune/biodiv>) that presents the current knowledge base of the river ecological and biological diversity.

**Results and discussion**

The portrait provides information on over 5,000 species of flora and fauna. On the website, you will find a detailed ecological analysis of the richness, rarity and vulnerability of several broad groups of plant and animal species. Furthermore, you will find a list of species for each of the 700 survey units and a distribution map for 2,500 species recorded along the St Lawrence, in atlas form, along with a detailed conservation plan. The plan encompasses the most unique and heterogeneous landscapes of the St Lawrence, some of which have no protection at present. The Portrait provides an overview of the sites that are currently protected by public agencies and private-sector organisations and identifies new sites of interest for conserving biodiversity and protecting species at risk.

**Keywords:** Atlas of biodiversity, St.Lawrence, Conservation plan, rarity of species, species at risk

**Domptail Stephanie, Marazzi Luca****Educating scientists for research on interdisciplinary biodiversity and ecosystem management. The students' perspective on 2008 AlterNet Summer School**

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Poster session P02, Biodiversity science and policy

**Background**

In order to effectively address the complexity and the urgency of present global environmental change, working in interdisciplinary teams and conducting transdisciplinary projects, are fundamental for research on biodiversity and ecosystem services and their management. The AlterNet Network (A Long-Term Biodiversity, Ecosystem and Awareness Research Network) aims to provide young researchers with the necessary skills for this new research context by organizing the AlterNet Summer School from 2006 to 2009. In the 2008 working group session, participants conducted a simili inter-sector assessment of ecosystem services in the Var catchment, France.

**Goal of study**

This work aims to identify the participants' main gains from the summer school in terms of skills and new conceptual frameworks to conduct effective research on ecosystems and biodiversity.

**Methods**

Individual summaries of the main insights obtained from the two weeks course were collected among the participants of the 2008 edition. A qualitative text analysis based on 12 responses was performed and a workshop synthesizing the lessons learnt was held with 16 participants.

**Results**

The lessons were classified under 13 themes, the main ones being: 1. science-policy communication and decision-making; 2. the role of scientists in the current global environmental crisis; 3. group work and its emerging properties as a tool for interdisciplinary work. These lessons learnt are themselves emerging properties of the summer school, gained thanks to individual and collective reflections and discussions among students and teachers during the class and in the post summer school workshop.

**Conclusion**

These over-arching issues are seldom addressed in academic curricula; yet from our student perspective, addressing them is crucial for the success of integrated scientific projects on today's global environmental challenges such as climate change and mass extinctions as well as to ensure their relevance to society.

**Keywords:** interdisciplinary education, ecosystem management, biodiversity research, AlterNet summer school, interdisciplinary skills

**El-Hassimi Sow Mounirou**, Laing Mark, Sido Y Amir, Sere Yacouba, Ndjiondjop Marie-Noelle  
**Screening a rice collection from Niger for resistance to Rice Yellow Mottle Virus (RYMV)**

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Poster session P03, Agrobiodiversity

Rice, with only 3% of the potential rice farming area being used, is the third crop after millet and sorghum in Niger, and the second source of calorie intake. Three cropping ecosystems including rainfed lowland, irrigated lowland and rainfed upland rice are found in the country. The overlapping of those different ecologies, coupled to the diversity of local farmers' knowledge might have influenced the population structure of *Oryza* species in the country. Additionally, the intensification of rice cropping and the high adaptation rate of Asian improved varieties are leading to the disappearance of local landraces and the emergence of biotic stresses such as Rice Yellow Mottle Virus (RYMV) and Bacterial Leaf Blight. To address these issues, a collection of rice germplasm was conducted in Niger in 2008. Fifty villages were visited and 195 samples collected. The collection is composed mainly by *Oryza sativa*. Additionally, *Oryza glaberrima* (1/3 of the collection) and wild relatives *O. barthii* and *O. longistaminata* were found in all the ecologies. Furthermore, in some villages of the Eastern region, old women were found to harvest wild *O. barthii* for consumption.

A set of 183 accessions from the collection was screened for RYMV resistance. At 42 day after inoculation, chlorophyll reduction (%SPADR), plant height reduction (%PHR) and disease incidence (%DI) were between 0.4-83.9%, 0.3-100% and 11.1-77.8% respectively. Twenty three accessions were resistant, 28 were mildly resistant, and 125 susceptible. Among the 23 resistant accessions, 19 were confirmed virus negative by ELISA, which additionally confirmed their resistance to RYMV. Finally, the collection was characterized in the field for agromorphological traits.

Further screenings remain to be done and the genetic diversity of the collection will be assessed using SSR markers. This first collection of rice from Niger constitutes a major source to widen the gene pool of rice breeding programs.

**Keywords:** Rice, Collection, RYMV, *O. glaberrima*, Niger

**El-Sheikh Mohamed**

**The Construction of the National Vegetation Survey Databank "EGYPT Vegetation Archive"**

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Poster session P17, Monitoring biodiversity

Egypt is part of the Sahara 'North African Desert' with arid climate. Its area is about one million km<sup>2</sup> divided by the River Nile. It has many phytogeographical regions such as 1. Nile region (valley, Delta, and Faiyum) 2. Oases of Western desert (wadi Natrun, Siwa, Farafra, Bahariya, Kharga, Dakhla, Kurkur, Dungul and uweinat), 3. The Mediterranean coastal strip, 4. Desert (Arabian Eastern 'east of Nile' and Western Libyan desert 'west of Nile'), 5. Red sea coast, 6. Gebel Eilba (south east corner at Sudan frontier), 7. Sinai proper (south of El-Tih desert). Therefore, the biogeographical belts are: The Mediterranean, the Saharo-Arabian and Sudano-Deccanian; the highlands of southern Sinai represent an outpost of the Irano-Turanian biota; and the highlands of the Southeastern corner of Egypt (the Elba region) represent the Northeast outpost of the biota of the Ethiopian highlands.

EGYPT working group on vegetation databases is dedicated to the promotion of a plot databank, in order to facilitate the application of botanical data, to open up new paths of analysis and to encourage exchange among scientists and practitioners. As a section of the Network for Phytodiversity we co-ordinate activities concerning the stimulation, capture, dissemination and utilisation of vegetation data in Egypt. This project is dedicated to the links between plant trait and vegetation data bases. Trait data summarise morphological and physiological features of plant species - plot data present a detailed description of the biotic environment in which the species are found. Linking trait and plot data banks allows us to extract the functional features of plant communities as well as to test and refine plant functional types.

**Keywords:** Biogeographical belts, Databank, Mediterranean, Phytodiversity, Sahara

**Emma M. Birdsey**, Poore Alistair G.B., Johnston Emma L.

**Exotic animal associations: Sessile marine animals and their mobile epifauna**

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Poster session P12, Biodiversity and climate change

It is well known that habitat modification and exotic species introductions are leading causes of global biodiversity change. So when exotic species also form the habitat for a whole array of associated species, the presence of an exotic species may have severe ramifications for native biodiversity. To understand this further, knowledge of species associations are crucial. In marine ecosystems, ever increasing anthropogenic disturbances are resulting in greater numbers of exotic species introductions, especially in coastal cities. In subtidal ecosystems, many mobile animals use sessile animals for habitat. Many of the sessile animals found in ports and harbours (e.g. sea mats and moss, tunicates, barnacles, tube-dwelling worms, and sponges) are non-indigenous, introduced via hull fouling or ballast water release. We investigated exotic sessile species on the diversity of associated mobile epifauna (e.g., sea slugs, crabs, amphipods, snails, and worms) and native co-occurring habitat-forming species. We sampled sessile assemblages and their mobile associates, over a 13 month long period, using experimental marine communities submerged at two sites in Sydney Harbour, Australia. We hypothesised that fewer mobile epifauna species and native sessile species would be found in communities with greater exotic sessile species dominance (i.e., % cover). My results show strong relatedness between sessile animals the mobile species associated with them. Also, the percentage cover of sessile species does not correlate with mobile species richness, thus the role species play, is likely to be crucial when predicting marine biodiversity. Furthermore, there was no relationship between the proportion of exotic species dominance and species richness and associated mobile epifauna. However, significant results were found for when mobile major taxonomic groups were used as the dependent variable. Detailed knowledge of inter-species animal association patterns is required to understand the persistence of exotic species and their consequences to community structure and biological diversity.

**Keywords:** Invasive species, animal associations, habitat-forming animals, marine ecology, biodiversity ecosystem functioning

**Ernstson Henrik**

**The social practice of articulating the value of urban landscape ecological processes:**

**Cases from Stockholm and Cape Town**

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Poster session P04, Managing biodiversity with a social-ecological system focus

**Background and goal**

With rapid worldwide urbanization, it is urgent to understand social practices leading to an improved ability to sustain urban biodiversity and ecosystem services. This requires that landscape ecological structures like habitat patches and green corridors are seen as having a greater value than other competing land-use interests, or else they disappear, which should rather be pursued as a sociological, than an ecological question. The goal of this study is to analyze the networks of civil-society organizations, researchers, and civil servants, and the social practices they employ in articulating the value of landscape ecological structures so as to influence urban decision-making. The goal is also to start building a theory for understanding how, sociologically speaking, urban ecosystem services are rendered a value.

**Materials and methods**

The study builds on case studies from Stockholm (Sweden) and Cape Town (South Africa). Interviews, participatory observations and social networks have been analyzed using theories from sociology, especially framing theory and actor-network theory.

**Results and discussion**

The result shows that ecological processes in themselves are not enough. In both cases, social actors also mobilized artistic and cultural-historical artefacts and created narratives able to explain that green areas previously perceived as detached, actually were linked through 'corridors'. In Stockholm, the royal heritage of green areas pointed to connectivity, and in Cape Town a 500 year old myth about a Khoi Princess played a key role. Departing from this, the paper discusses how conservation practices and natural resource management is embedded in social and cultural contexts.

**Keywords:** value creation, ecosystem services, actor-networks, urban, land-use

**Espíndola Anahí**, Alvarez Nadir**Does nursery pollination promote species diversification in the West-Palearctic?**

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Poster session P06, Biological diversification

**Background and goal of study**

In specific and obligate mutualisms, the fate of organisms is intimately tied to the survival of their partners. Nursery pollination systems – where food and shelter are provided by the plant and pollen is distributed by the insect – are thought to be reciprocal relationships that are strong enough to promote co-speciation, as well as sympatric diversification, in interacting lineages. In addition to such ecological speciation, vicariant speciation may also occur, particularly in areas strongly affected by climatic oscillations. The Eurasian globe-flower *Trollius europaeus* and its *Chiastocheta* fly pollinators represent an appropriate model system for evaluating the role played by both ecological and vicariant speciation in the diversification of insects.

**Materials and methods**

An extensive pollinator sampling was performed over the West-Eurasian distribution range of *T. europaeus*. Insects were identified and mitochondrial and nuclear regions were amplified for phylogenetic analyses. Additionally, distribution maps and ecological niche modelling were used to evaluate the effective occurrence of the different pollinating species as well as to identify the presence of potential regional taxa.

**Results and discussion**

Boundaries of morphologically recognized species were not well defined and patterns of speciation were more intricate than previously assumed. Molecular markers support the existence of fewer taxa than those identified morphologically. This indicates that the role of ecological specialization may not be as crucial to the diversification process as proposed, whereas vicariance appears to play a more extensive role in this process.

**Conclusion**

Our results demonstrate that the globe-flower does not necessarily promote ecological speciation in associated fly species, and that the flies were probably subject to a combination of the diversifying processes of geographic isolation and partial ecological specialization.

**Keywords:** mutualism, ecological speciation, phylogeography, vicariance, plant-insect interactions

**Fandohan Adandé Belarmain**, Sinsin Brice**Impact of human pressure on the viability of tamarind (*Tamarindus indica* L.) populations in W Trans-boundary****Bio-reserve**

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Poster session P05, Drivers of biodiversity

The conservation status of many wild fruit tree species that support rural people in Africa remains poorly documented despite their importance. *T. indica* is a dryland species that has nutritional, medicinal and cultural importance for rural communities. We compared the viability of the species' populations under different human-pressure levels, i.e. gallery forests, savannah woodlands, and farmlands, using dendrometric characterization and diameter size distributions. Tamarind trees density and regeneration (expressed as stems/hectare) are found to be relatively low compared to other species of the same ecosystem, suggesting tamarind populations may not be self-rejuvenating. Nonetheless, tamarind density in gallery forests is 3-8 times higher than that in savannah woodlands and farmlands ( $P < 0.001$ ). Although diametric structures' coefficients of skewness indicate declining populations irrespective of human-pressure levels, higher median diameter values suggest the species' populations in farmlands and savannah woodlands to be more vulnerable than those occurring in gallery forests. These findings suggest that gallery forests are the best habitats for tamarind species in situ conservation. The observed reduction of trees and juveniles in farmlands and woodlands suggests a drawback on the long-term viability of tamarind populations in these areas.

**Keywords:** *Tamarindus indica*, density, regeneration, stem diameter structure, Benin

Feintrenie Laurène, Levang Patrice, **Jean-Laurent Pfund**  
**Agrobiodiversity helps farmers to cope with the global economic crisis.**

**A case study in Bungo district, Sumatra, Indonesia**

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Poster session P01, Economics of biodiversity

Rubber agroforests combine rubber trees with other useful plants (timber, fruit trees, rattans and bamboos). Though praised by ecologists as being wonderfully sustainable these agroforests along with rice paddies are increasingly converted into monospecific oil palm or rubber plantations. This paper assesses the contribution of agroforests to local livelihoods and anticipates the consequences of the global crisis on agroforests' conservation and on agrobiodiversity.

The profitability of rubber agroforests has been assessed through the inventory of useful plants in 18 plots and complementary interviews of smallholders. A profitability analysis of oil palm and rubber smallholdings has been conducted to compare returns to land and labour of the three cropping systems, in conditions of high (September 2008) and low prices (January 2009). The contribution of secondary products was estimated through socio-economic household surveys in 2007-08, with an update in January 2009. Shopkeepers, market sellers and middlemen were interviewed to assess the impact of the crisis on customers' behaviour.

With the price slump of the main commodity, fruits and vegetables from the agroforests served as a safety net for the poorest households. However, collecting secondary products can only be considered as a stopgap solution as income provided does not compensate for the loss of income from rubber. The harvested quantities remain limited and are mostly seasonal, and markets for these products remain limited.

The economic crisis, with the business slump of rubber and palm oil, is a good illustration of the dangers of specialisation. Since the crisis, agroforests and paddy fields are prevalent again. However, this might not last. Lessons from the crisis could serve to revisit former land development plans at village and district levels, including the preservation of agroforests and paddy fields (even as fallows) in a (bio) diverse landscape mosaic.

**Keywords:** rubber agroforest, oil palm plantation, non timber forest product, income diversification, farming intensification

**Fidalgo Beatriz**, Salas-González Raúl, Gaspar José, Morais Paulo

**Monitoring plant species diversity in cultivated landscapes: The role of landscape structural indices**

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Poster session P17, Monitoring biodiversity

**Background and goal of study**

The formulation of policies for land use management requires knowledge on trends in land use change. Beyond the quantitative dimension, it is now largely accepted that the spatial distribution of land uses/cover classes, need to be considered in order to understand biodiversity patterns. Cultural landscapes are diverse and dynamic, particularly where multiple owners' individual actions shape forested landscapes. This work aims to study the hypothetical relationships between structural characteristics of the landscapes, and the biodiversity of plant species.

**Materials and methods**

The study was conducted in Portugal, (138 km<sup>2</sup>). A time span of forty years was analyzed based on land cover maps derived from aerial photographs. Land cover changes were quantified and a set of landscape metrics were calculated. A multi-scale field inventory was conducted to assess plant species diversity in forests. The relation between species diversity and landscape metrics was investigated using multiple linear regression models.

**Results and discussion**

Changes in land use/cover occur in relatively short periods of time and high magnitude. Significant differences between plant diversity in forest types were found. Results support the need for a selection of few metrics for landscape characterization and monitoring. A large range of variations in metrics was found at class level. The relationship between the number of total species and metrics was found more relevant at class level than at patch level.

**Conclusion**

The methodological approach proved to be adequate to select a smaller set of metrics relevant for biodiversity monitoring. Metrics found important for landscape characterization were not all coincident with metrics having a significant relation with species diversity. Thus, an approach combining statistical analysis and expert knowledge in order to select relevant indices for biodiversity change monitoring.

**Keywords:** plant species diversity, biodiversity monitoring, landscape metrics, landscape change, cultivated forests

Fitriana Yulia Rahma, Levang Patrice, **Pfund Jean-Laurent**

**Contribution of illegal coffee plantations to household economies:****A case study in the Bukit Barisan Selatan National Park, Indonesia**

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Poster session P11, Conservation, conflicts resolution and development

At present, more than 30,000 households are encroaching the fact that the Bukit Barisan Selatan National Park is converting huge tracts of forests into coffee plantations. Local authorities oppose any attempt of forcible eviction of squatters unless proper compensations are made available. The research goal is to assess the actual contribution of coffee smallholdings inside the Park to households' economy. Such data are indispensable to evaluate the minimum level of compensation which should be provided through a Payment for Environmental Services (PES). Three types of households take advantage of the Park. First, absentee plantation owners who entrust their plot to neighbours and only show up for harvesting. Second, villagers living around the Park often own an additional plot inside the Park. Third, households living in precarious conditions sometimes far inside the Park. A representative sample of households (150 total) has been surveyed and monitored during a whole harvesting season. Special attention was given to household's income stemming from activities inside the Park. According to the type of squatter, the contribution of the Park to the household's income is quite contrasted, and so are the solutions of the problem. Absentee landowners merely take advantage of the presently lean law enforcement to complement their income. Villagers around the Park increase their holdings by buying additional plots inside the Park. Squatters living permanently inside the Park have no other livelihood opportunity and are totally dependent on the Park for their subsistence. While the former could be convinced to leave the Park, the latter need to be offered compensations or at least alternative livelihood opportunities. The estimation of the actual economic contribution from the Park to the households' economy is an absolute prerequisite in order to determine the minimum levels of PES and the more suitable rewarding mechanisms to propose to illegal occupants in the Park.

**Keywords:** Payment for Environmental Services, Protected Areas, National park, Encroachment, Rewarding mechanisms

Fonte Steven J., **Barrios Edmundo**, Six Johan

**Earthworms, soil fertility and aggregate-associated soil organic matter dynamics in the Quesungual agroforestry system**

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Poster session P03, Agrobiodiversity

**Background**

Issues of food security, environmental degradation and climate change underscore the need for the improved understanding of sustainable agricultural systems around the globe. The Quesungual agroforestry system of Western Honduras offers a promising alternative to traditional slash-and-burn agriculture for the mountainous tropical dry forest zones of Central America.

**Materials and methods**

This study examined earthworm populations, soil fertility and soil organic matter dynamics by comparing the Quesungual system with slash-and-burn agriculture (both with and without fertilizer) and uncultivated forest in a replicated field trial. Dried surface soils (0-15cm) were fractionated by wet sieving to look at the distribution of C and N among soil aggregate size classes, as well as changes in whole soil C and N since forest conversion. P availability was measured in bulk soils, while earthworms were assessed by excavation and hand sorting in each plot.

**Results and discussion**

Earthworm populations were larger under Quesungual versus slash-and-burn plots (13.4 vs. 0.8 g fresh biomass m<sup>-2</sup>; respectively). The Quesungual system enhanced the availability of added inorganic P, such that fertilization increased P availability three times more in Quesungual than in slash-and-burn plots. No major differences in soil organic matter storage were found between the two cropping systems.

However, earlier conversion of Quesungual plots from forest suggests that the overall rate of C loss was lower under Quesungual management. Relative to native forest, both cropping systems experienced a dramatic loss of C (average 5 g C kg<sup>-1</sup> soil) over the 2 yr study period and this loss was mainly associated with the disruption of C rich large macroaggregates (> 2000 µm).

### Conclusion

Results from this study suggest that the Quesungual system offers great potential to improve soil fertility and biological health relative to traditional slash-and-burn agriculture.

**Keywords:** Earthworms, Soil Carbon, P availability, Agroforestry, Honduras

## Franzén Markus

### How can we preserve and restore species richness of pollinating insects on agricultural land?

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Poster session P18, Managing for ecosystem services

During recent decades, concern about the loss of biodiversity on agricultural land has increased, and semi-natural grasslands have been highlighted as critical habitats. Temperate European agricultural landscapes require distinct and appropriate management to prevent further impoverishment of the flora and fauna. This is especially urgent for pollinating insects that provide important ecosystem services. Our aim was to examine how species richness of three important groups of pollinating insects; solitary bees, butterflies and burnet moths are related to different farm characteristics, and if there are any differences between these three groups. A further aim was to test if red-listed species are related to any farm characteristics. Species richness of solitary bees, butterflies and burnets was measured on all seminatural grasslands at 16 farms in a forest-dominated area of 50 km<sup>2</sup> in Southern Sweden, using systematic transect walks in April to September 2003 (only butterflies and burnets) and 2005. The species richness of solitary bees and butterflies was intercorrelated, both before and after controlling for the area of semi-natural grassland. The species richness of solitary bees increased with the area of semi-natural grassland. After controlling for the effect of the area of semi-natural grassland species richness was strongly positively related to the density of the plant *Knautia arvensis* and negatively related to the proportion of grazed grassland. The results were similar for solitary bees and butterflies. The number of red-listed solitary bees was positively related to the proportion of meadows with late harvest (after mid-July) and decreased with increased farm isolation. The number of burnet species (all red-listed) was positively related to vegetation height, flower density and the proportion of meadows with late harvest on a farm.

**Keywords:** biodiversity indicator, butterfly, solitary bee, hay-meadow, landscape

## Freckleton Rebeka, Lockie Stewart

### Market-based instruments and the conservation of biodiversity on private land

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Poster session P01, Economics of biodiversity

### Background and goal

Market based instruments (MBIs) are increasingly used in Australia to manage natural resource problems. MBIs are designed to help land managers absorb the costs of environmental protection while providing cost effective and targeted delivery of natural resource funding. However, MBIs have been criticised for failing to deliver adequate environmental outcomes, as well as for lacking mechanisms to enable land managers to absorb or pass on the costs of environmental protection. This study investigated the impact of MBIs on landholders' potential to help share the cost of biodiversity conservation.

### Materials and methods

This study assessed three government funded MBI projects in Australia through qualitative interviews with land managers and natural resource management staff. Each project targeted biodiversity conservation on agricultural land. Data were analysed using the N'Vivo software.

### Results and discussion

This study found that short-term, targeted and cost-effective biodiversity conservation was possible through MBIs. These programs assisted in building landholder understanding of the relationships between productivity and biodiversity. However, payments rarely covered the full cost to landholders of biodiversity conservation, resulting in the recruitment of participants who were likely to have provided the

desired conservation outcome without financial incentives. Indeed, payments were made to many landholders for little change in management practice. There was no evidence of MBIs providing a means through which landholders were able to absorb or pass on the costs of environmental protection.

### Conclusion

The MBIs in this study achieved reportable short-term benefits. However a cautious approach should be taken if significant funding is to be delivered through MBIs. At the very least, these findings suggest that while MBIs may be a promising policy tool, in the forms assessed in this study they are unlikely to secure durable biodiversity outcomes.

**Keywords:** Market based instruments, biodiversity, policy, Australia, agriculture

### **Galvez-Bravo Lucia, Cayuela Luis**

#### **The Tree Biodiversity Network (BIOTREE): Prospects for biodiversity research and conservation in the tropics**

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Poster session P17, Monitoring biodiversity

One of the main conservation problems in most tropical regions is the lack of data on species distributions. Although different initiatives, such as the GBIF, have attempted to provide access to biological surveys and collections throughout the world, the data are notably deficient in many of the world's biodiversity hotspots. Central America is one of such regions, where despite its high biodiversity there is a scarcity of available data for many species. In response to the lack of information about species distributions in Central America, we have established a network of forest inventory plots (BIOTREE). This network aims to promote research and biodiversity conservation in this highly diverse region by integrating information about tree species distributions with available data about environmental variables and ecological features. Through this network we also want to stimulate data exchange and collaboration between scientists from around the world. The BIOTREE network has been growing for the last 2 years, and currently includes data from over 1400 inventories for Mexico, Belize, Honduras, El Salvador, Nicaragua, Costa Rica, and Panama, and 30 researchers from 11 different countries have already joined the network. In the future, the BIOTREE network will make these data available through a web server, and it will allow access to information about tree distributions and their main ecological attributes to different types of users. This information will be useful for updating the conservation status of many species according to IUCN criteria. Overall, we believe this initiative will benefit botanists, forest ecologists, and conservation biologists, as well as local and national government agencies. We hope that this network will help improve the effectiveness of conservation efforts in Central America, and complement larger existing databases such as the GBIF.

**Keywords:** inventories, network, CentralAmerica, forests, biodiversity

### **Gama Lilia, Villanueva Claudia, Diaz Hilda, Collado Ricardo, Pacheco Coral, De Dios Juan**

#### **Biodiversity changes expected in Tabasco, Mexico wetlands due to global warming**

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Poster session P12, Biodiversity and climate change

The state of Tabasco is home of one of the most important wetland reserves of Southern Mexico "Pantanos de Centla". It is located on the delta of the Grijalva and Usumacinta rivers. It has nearly 60 species of fish, 85 reptiles, 26 amphibians, 103 mammals, and 260 plants. It has deep, acidic soils, rich in organic matter deposited from flooding stream that configure one of the most productive soils in Mexico. It is one of the last refuges for the peje lagarto, a gar fish as well as the Moreletii. Oil exploitation, cattle breeding and agriculture are the main economic activities and responsible for an important loss of natural ecosystems and a lack of resources and alternatives for local poverty communities of the area. The objective of this research was to study global warming effects on this area. A historical review of the hydrology, land use, and probable scenarios related to heat, rainfall modification and raise of sea level were performed. Ecosystem vulnerability was evaluated. Results show that this area is situated in a vast plateau. There has been an important loss of the original biodiversity due mainly to farming and poor cattle management activities and oil exploitation. Although important incomes had come from oil exploitation, the degree of poverty of the population is high. Road infrastructure, unplanned urban growth, and the oil exploitation infrastructure, have caused important impacts especially on the hydrodynamic and coastal areas. Salt water intrusions during the dry season allow mangroves in this region to grow up to 30 km inland. However, a strong effect of salinization on soils is affecting agricultural uses. The moist forests have been gradually eliminated over the years due to their importance as a source of food and timber for local villagers. Local fisheries, deforestation for agricultural purposes, and cattle grazing and industrial pollution are currently the major threats.

**Keywords:** Wetlands, global warming, ecosystem services, landscape ecology, oil exploitation

## **Gasura Edmore**

### **Implications of breeding on loss and conservation of sweetpotato diversity**

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Poster session P03, Agrobiodiversity

Sweetpotato ranks fifth most important food crop in developing countries. The primary center of sweetpotato diversity is Central and South America. Since then, many genotypes were created through natural hybridization and mutations. Great genetic diversity of sweetpotato was reported in East Africa especially in Uganda. However, breeding and cultivation resulted in the loss of sweetpotato diversity. The objective of the study was to verify the impact of sweetpotato breeding and the selection on sweetpotato diversity loss, and to characterize and conserve the available germplasm. A survey was conducted all over Uganda, and farmers were asked to give reasons of growing specific cultivars. From every farmer, five vines per cultivar were collected. A total of 1,302 cultivars composed of landraces, locally bred clones and introductions were collected and characterized at Makerere University using morphological and RAPD markers. Phenotypic and molecular data were coded into binary. Phylogenetic analyses were conducted using Treecon software. Farmers in the Central and Western parts of Uganda grew only a few cultivars that resist abiotic stress especially the widespread sweet potato virus disease and *alteneria* leaf and stem blight disease. This has narrowed the number of genotypes found in these areas compared to the eastern part of Uganda where many different genotypes are grown due to low disease pressure. Breeding and selection results in loss of sweetpotato diversity, although cluster analyses showed the existence of a broad genetic diversity of sweetpotato. Therefore, breeding and selection should be done while conserving the available germplasm to avoid genetic erosion. A logical conservation program must have few genotypes conserved that capture an enormous diversity spectrum available. Such diversity is needed to provide a wide genetic base for further sweetpotato improvement and to maintain the ecosystem functions.

**Keywords:** genetic diversity, characterization, phylogenetics, conservation, Sweetpotato

## **Gauthier Claude-Anne, Le Roux Xavier**

### **A tool for new biodiversity research opportunities: the French Foundation for Biodiversity Research**

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Poster session P20, National DIVERSITAS Committees and National Programmes

The FBR has been set up in February 2008 by the Ministers for Ecology and Research and the eight national research institutes working on biodiversity. Its main purpose is to bring together public research bodies, the corporate sector involved in biodiversity management, environmental organizations, and business, in order to meet the biodiversity research challenge. FRB is the National Committee for DIVERSITAS since March 2008.

In accordance with the policies of the French National Biodiversity Strategy (2005), the objective of the FRB is to encourage at the national, community, and international levels the development, backing and promotion of research activities in biodiversity, and their utilization in the biological, socio-economic, and legal fields.

The actions of the FBR:

- Characterizing and assessing biodiversity
- Understanding the dynamics of biodiversity and predicting its changes
- Assessing the ecological, economic, and social impacts of biodiversity change
- Developing practices of sustainable use and conservation of domestic biological resources, species, and their habitats.

To carry out its missions, the FBR relies on four interactive working bodies:

- a strategic policy committee acts as an interface between academic research, the business world, and the civil society,
- a board of directors is supervising the activities,
- a scientific council develops the scientific strategy and the annual agenda,
- an executive team (25) including the director, is promoting and implementing the actions.

Key current actions include: the development of the French Biodiversity Research Strategy; the launch of joint calls (e.g. in 2009, FRB call for blue sky biodiversity research; ANR call on 'biodiversity loss'; a call supported by a firm on 'agriculture & biodiversity'); the coordination of the ERA NET 'BiodivERsA'; use of the FRB stakeholders committee to develop an interface between science, the business world, and the civil society, and to promote innovative biodiversity research.

**Keywords:** foundation, research strategy, science, policy interface, joint call

**Ghebrehiwet Dawit Yemane**, Field John G., Leslie Rob W.

**Exploring the consequence of spatial scale on spatio-temporal pattern in diversity: using the South coast of South Africa as case study**

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Poster session P13, Analysing patterns and trends

**Background and goal of study**

The patterns in diversity and the processes affecting observed patterns of the fauna and flora of various ecosystems have been the subject of many studies. Part of these studies was conducted to track changes in the ecosystem, to understand the functioning of ecosystems, and in part because of the link between diversity and stability/resilience of ecosystems. Despite the interest and effort in biodiversity and its relation to other attributes of ecosystems, reported findings related to the pattern and direction of the relationship tend to be affected by the choice of the diversity index and the spatial scale, at which measurement was conducted. To this end this study explores spatio-temporal patterns in diversity when diversity is calculated at different spatial scales.

**Materials and methods**

This study is conducted based on data obtained from a trawl survey on the South coast of South Africa. Sampling stations were incrementally aggregated, then diversity indices were calculated at each scale and temporal change in diversity was assessed. A Generalized Additive Model (GAM) was fitted to suite of diversity indices calculated at each scale.

**Results and discussion**

The result shows that spatio-temporal patterns in diversity change with the decrease in spatial resolution. This study gives insight on how tracking temporal changes in the diversity of communities might be affected by the choice of the spatial scale upon which diversity indices are calculated.

**Keywords:** spatial scale, temporal, pattern, diversity, GAM

**Gillson Lindsey**, Ekblom Anneli

**Resilience and thresholds in savannahs: nitrogen and fire as drivers and responders of vegetation transition**

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Poster session P05, Drivers of biodiversity

**Background and goal of study**

Resilience theory suggests that ecosystems can persist for long periods, before changing rapidly to a new vegetation phase. The transition between phases occurs when ecological thresholds have been crossed, and is followed by a reorganization of biotic and environmental interactions, leading to the emergence of a new vegetation phase or quasi-stable state. Savannahs are dynamic and complex systems in which fire, herbivory, water, and nutrient availability interact to determine tree abundance. The phase and the transition have been observed in savannahs, but the role of these different possible drivers is not always clear. In this study, our objectives were to identify the phase and the transition in the fossil pollen record, and then to explore the role of nitrogen and fire in these transitions using  $\delta^{15}\text{N}$  isotopes and charcoal abundance.

**Materials and methods**

We present palaeoenvironmental data (fossil pollen, charcoal, and stable isotopes) from the Kruger National Park, South Africa, which show the transition between grassland and savannah phases.

**Results and discussion**

Use SI units for all measurements. Our results show the transition at the end of the 9th Century A.D from a nutrient- and herbivore-limited grazing lawn, in which fire was absent and C4 grasses were the dominant and competitively superior plant form, to a water, fire and herbivory limited semi-arid savannah, in which C4 grasses and C3 trees and shrubs co-existed.

**Conclusions**

The data accord with theoretical frameworks that predict that variability in ecosystems clusters in regions of higher probability space, interspersed by rapid transitions between these phases. The data are also consistent with the idea that phase transitions involve the switching between different dominant driving processes or limiting factors.

**Keywords:** feedbacks, isotopes, pollen, charcoal, isotopes

**Gole Tadesse Woldemariam**, Senbeta Feyera, Denich Manfred, Gatzweiler Franz  
**Coffee forest biosphere reserve in Ethiopia: a long journey from research to implementation**

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Poster session P02, Biodiversity science and policy

Ethiopia is the center of the origin and the diversity of coffee (*Coffea arabica*). The wild populations of this economically important species are found in the Afromontane rainforests in the Southwestern and Southeastern parts of the country. The remnant coffee forests are highly threatened by deforestation. A multidisciplinary research work over the last seven years has revealed the importance of coffee forests for the conservation of coffee genetic diversity, plant species diversity, the national economy and local livelihoods. For the sustainability of development and the conservation of biodiversity at all levels, the UNESCO biosphere reserve approach has been recommended as the best management option. The preparation for the nomination of one of the remnant coffee forests, the Yayu Coffee Forest Biosphere Reserve has been underway since 2006, and is now ready for submission to the UNESCO MAB programme. This paper documents the lessons learnt in the process, spanning from research to the nomination process and the implementation practices.

**Keywords:** Coffee, Ethiopia, Conservation, Biosphere reserve, genetic resource

**Gonzalez Andrew**, Mouquet Nicolas, Loreau Michel

**Biodiversity as spatial insurance: understanding the impacts of habitat fragmentation on ecosystem functioning**

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Poster session P05, Drivers of biodiversity

Anthropogenic habitat destruction, the conversion to agriculture, and fragmentation are generally considered to be the dominant drivers of biodiversity change. The loss of biodiversity in fragmented landscapes has underscored the importance of viewing communities as 'open' structures dependent upon spatial fluxes from the surrounding communities in the region. Although the importance of dispersal for the maintenance of biodiversity is well understood, its importance for ecosystem functioning remains relatively unexplored. A more complete understanding of the impacts of biodiversity loss on ecosystem functioning requires a fuller understanding of spatial processes. At regional, or metacommunity, scales the spatial components of diversity — both spatial variance in diversity among habitats or patches and turnover in composition from patch to patch — are significant determinants of ecosystem functioning at scales greater than the local patch. We present a framework for understanding how spatial processes mediate the biodiversity-ecosystem functioning relationship in fragmented landscapes. We focus on three theoretical notions that are essential to this framework. First, we consider how the species-area relationship can link the loss of habitat to the delayed loss of diversity and ecosystem functioning in remnant fragments. Second, we show how the spatial variance in biodiversity can affect estimates of regional ecosystem functioning by non-linear averaging. Finally, we use a metacommunity framework to formalise the spatial insurance hypothesis. This theory predicts highly nonlinear effects of habitat loss and altered landscape connectivity on the biodiversity-ecosystem functioning relationship at landscape scales. We conclude that empirical research is now needed to test this theory, and to refine our understanding of the ecological and economic impacts of biodiversity loss.

**Keywords:** metacommunity, insurance hypothesis, dispersal, extinction, functioning debt

**Govender Danny**, Sam Ferreira, Hendrik Sithole and Craig McLoughlin

**Biodiversity warning signs presage crocodile deaths in the Kruger National Park**

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Poster session P16, Biodiversity indicators

**Background**

The deterioration of water quality is one of the most critical responses to environmental degradation. Such degradation often leads to cascade effects at several trophic levels in aquatic foodwebs. Typically, degradation effects accumulate slowly, but when thresholds are reached, responses are accelerated and species at the top of the foodwebs can show rapid responses.

**Results and discussion**

Recent deaths of crocodiles epitomize such a scenario. The catchment of the Olifants River has experienced for some time increasing pressures on water resources and deterioration of water quality. Even so, we can at best speculate on events preceding the recorded deaths of 170 crocodiles due to pansteatitis.

Macroinvertebrate assemblages and fish responses to modified environmental conditions are measured using the South African Scoring System and the Fish Assemblage Integrity Index, respectively in the River Health Program. These lower trophic level responses are meant to reflect the prevailing flow regime and water quality in the river and serve as an early warning system for management actions. Despite these monitoring processes in place, feedback loops were not complete to capture the subtle losses in biodiversity, affect institutional learning, and implement management actions. An integrated investigation following the crocodile deaths showed that there had been an overall loss of up to 50% of macroinvertebrate taxa since 1986, a progressive loss of fish species integrity over the last few decades and a gradual silting up of deep pool environments within the river.

#### **Conclusion**

It is likely that a severely stressed system experienced an acute event that induced deaths of an apex predator that was perpetuated by epidemiological-like density-dependent processes. The incident highlighted that though pre-emptive early warning systems are in place, organizational response tends to be driven by changes to apex species and charismatic megafauna. By then it is usually too late and the trigger of the event has frequently passed.

**Keywords:** Olifant's River, Crocodile Deaths, pansteatitis, biodiversity loss, macroinvertebrate

**Hadas Rivka**, Barazani Oz, Singer Alon, Perevolotsky Avi

#### **The native flora of Israel - Conservation and management**

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Poster session P19, Systematics and taxonomy

#### **Background and goal of study**

The Israel Plant Gene Bank (IGB), located at the Agricultural Research Organization, was established recently with the aim of conserving representative gene pools of the 2,600 species of the local flora. This action has become crucial in light of the increasing threat of genetic erosion and the need to save the national plant genetic resources. It is estimated that 6% of the total IL flora are endemic, 10% belong to gene pool 1 and 2 of important agricultural crops, and 350 additional species have some agronomical potential. However, enormously large numbers of 413 plant species are recorded in the red list, thus calling for an immediate conservation plan. Accordingly, special attention is given in IGB to distribution centers of crop wild relatives (CWR), rare-endangered and endemic species.

#### **Materials and methods**

To achieve this goal, a collection strategy was created taking into account genetic, biological and ecological parameters. The different parameters were used to rank species in accordance to their genetic relationship to cultivated crops, distribution range, abundance, and rarity of the growing habitats, endemism, and the red number index- representing imminent threat of extinction. Consequently, a prioritization list was created and used by IGB to organize its collection scheme.

#### **Results and discussion**

At the end of two years of activity, 2,000 seed samples were banked in the IGB state of the art facilities which include short and long term humidity controlled freezing rooms (4 °C and -20 °C). The banked samples belong to rare, endemic and endangered species, as well as CWRs and other plant genetic resources. In special cases, as in rare species, seed lots are created in IGB field sites, to enlarge the banked samples.

#### **Conclusion**

We expect that such collections will serve the scientific community as source for research and breeding programs, conservation activities as well as for restoration programs.

**Keywords:** Biodiversity, Ex-situ conservation, Gene bank, Genetic resources, Prioritization scheme

**Hautier Yann**, Niklaus Pascal, Hector Andy

**Competition for light causes plant biodiversity loss following eutrophication**

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Poster session P05, Drivers of biodiversity

**Background and goal of study**

The earth is undergoing rapid changes in biodiversity because of human activities. Specifically, humans have dramatically increased the availability of nutrients in terrestrial and aquatic ecosystems. In grasslands this eutrophication causes a loss of plant species diversity. Surprisingly, we lack a mechanistic understanding of how nutrient enrichment decreases plant diversity, even though alternative hypotheses were suggested decades ago.

**Materials and methods**

We used a novel manipulation of experimental grassland plant communities that restores light to the species in the lower canopy that are thought to decrease in diversity due to deeper shading following the increase in aboveground productivity caused by eutrophication.

**Results and discussion**

We found that the addition of light to the grassland understory reduced competition for light, sustained seedling establishment and maintained plant diversity despite the additional nutrient inputs. While other processes such as the competition for soil resources, and the acidification or accumulation of plant litter can also contribute to diversity loss, they played no detectable role in our study.

**Conclusion**

Our results advance a long running debate in community ecology by providing a direct experimental demonstration of the importance of competition for light as a mechanism of plant diversity loss. Our work explains the particular threat of eutrophication to plant diversity and emphasizes the need to develop conservation policies and management procedures that control nutrient enrichment if plant diversity is to be preserved.

**Keywords:** Nitrogen addition, aboveground competition, belowground competition, diversity loss, grassland

Hicks Natalie, Solan Martin, Bulling Mark, Raffaelli David, White Piran, Paterson David,

**Godbold Jasmin**

**Effect of future climate change scenarios on primary production in coastal marine ecosystems**

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Poster session P12, Biodiversity and climate change

**Background and goal**

Human induced climate change has already altered ecosystems worldwide, and further changes in carbon dioxide (CO<sub>2</sub>) and temperature are expected to have global consequences on marine ecosystem processes. Compared to terrestrial ecosystems, little research has been done in marine ecosystems to determine the possible impacts of rising temperature and carbon dioxide levels, particularly on microphytobenthos (MPB) which plays a major role in primary productivity, carbon cycling and sediment stabilisation. The interaction between the microphytobenthos and the sediment macrofauna in estuarine systems mediates the flux of nutrients in the water column and contributes significantly to global nutrient cycles.

**Methods and materials**

Using model benthic communities, we determine how the interactive effects of carbon dioxide, temperature, and invertebrate biodiversity loss affect microphytobenthic production. PAM fluorescence was used to monitor the response of the microphytobenthic community in environmental chambers capable of simulating current (370 ppm) versus future (600 ppm and 1000ppm) atmospheric concentrations of carbon dioxide at temperatures (6, 12 and 18°C), reflecting natural seasonal variation. Results are analysed using a mixed modelling framework which allows for the inherent heterogeneity of variance in the data.

**Results and conclusion**

Complex interactions between the CO<sub>2</sub> levels and temperatures make it difficult to predict ecosystem changes, but climate change is likely to impact MPB biomass, and thus primary production and trophic interactions, negatively. However, these effects are mediated by the

identity and diversity of infaunal invertebrates. If we are to fully understand the consequences of climate change, our findings suggest that multiple drivers must be studied simultaneously rather than additively.

**Keywords:** climate change, ecosystem function, primary production, microphytobenthos, carbon dioxide

Hillmann Boris, Barkmann Jan, Marggraf Rainer, **Kristin Schröder**  
**Costs and benefits of ecosystem services of the Podocarpus National Park in Southern Ecuador shared on local, regional, and global scales**

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 Poster session P01, Economics of biodiversity

**Background and goal of the study**

Recent estimates of the net present value of the conservation of primary ecosystems at a per hectare basis imply that the ecosystem conservation is up to 100 times as beneficial in economic terms than their conversion to agriculture or intensive silviculture. A substantial share of these benefits stems from the monetary expression of existence values as stated by OECD citizens. These 'willingness-to-pay' (WTP) figures are then applied to conservation priority areas (mostly) in developing countries, in this case the Podocarpus National Park in Southern Ecuador.

**Material and methods**

Estimates from the literature for costs and benefits of nature conservation are extrapolated and applied. In the summer of 2009, we gathered empiric data of WTP via stated preference techniques (choice experiment) from local farmers and regional citizens of two towns living near the park, and from global stakeholders represented by citizens of Germany. Results will be presented at the conference.

**Results and discussion**

The WTP for German citizens for additional international biodiversity conservation in developing countries in the coming 10 years is about US\$ 143/yr. Assuming that this figure actually is a proxy for the maximum WTP by each of ~290 million OECD households, roughly US\$ 41 billion/yr could be generated. The total area of remaining primary vegetation in the 25 global biodiversity hotspots amounts to 2.123 million km<sup>2</sup> resulting in a WTP for conservation activities for about US\$ 195/ha/yr. In Southern Ecuador, the most profitable land use form for farmers is cattle farming at a net profit of about US\$ 87/ha/yr.

**Conclusion**

Opportunity costs could be covered by transfer payments of the private sector. For an effective and efficient conservation strategy policy makers should consider the opportunity to share costs of biodiversity conservation with global private stakeholders as biodiversity is a common good.

**Keywords:** choice experiment, cost-benefit-analysis, Ecuador, willingness-to-pay, nature conservation

Hiltbrunner Erika, Inauen Nicole, **Körner Christian**  
**Ecological and hydrological consequences of land use change in subalpine and alpine grasslands in the Swiss Alps**

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 Poster session P05, Drivers of biodiversity

**Background, goal**

The European Alps are the most intensively exploited mountain region in the world, inhabited by 13.6 Mio people and visited by c. 120 Mio visitors every year. Primary resources are agricultural production, landscape values (e.g. tourism) and hydroelectric power. Regardless of this exploitation, the Alps still host Europe's largest pool of plant species in highly diverse landscapes. Ongoing transitions in land use, climatic changes and socio-economic processes are affecting ecosystem goods and services of alpine areas with vital effects for the forelands. Reduced farming activities have led to massive shrub and forest expansion into formerly open habitats. Species-rich plant communities and diverse landscapes in alpine regions will further decline with current trends in land use. These land cover changes will affect evapotranspiration and runoff (amount, quality), thus, with hydrological consequences for high- and the adjacent lowlands.

**Material, methods**

The water balance of different vegetation types (combined with grazing) was assessed by lysimeters in the central Swiss Alps at 2450 m (a.s.l.). Water quality (nitrate) was monitored in shrubland dominated by green alder, a N<sub>2</sub>-fixing species that currently expands enormously into grasslands at high elevation.

**Results, discussion**

Reducing farming activities causes shifts in plant diversity, but also affects evapotranspiration by inducing taller plant canopies that transpire more than short, grazed swards. Alder encroachment into grasslands leads to altered water balance due to the increased interception and the higher transpiration, thus, reducing runoff but contributing to eutrophication by increased nitrate leaching.

**Conclusion**

The most apparent impact of land use is the transformation of vegetation structures, biodiversity, and soil properties. Besides higher plant diversity, a commonly unaccounted benefit of extensive and sustainable grazing on highlands is increased water yield, thus, enhanced catchment.

**Keywords:** alpine grassland, grazing, hydrology, shrub encroachment, nitrate leaching

**Huettmann Falk****Investigating the global economic growth conflict with biodiversity, habitat and wilderness using national and international performance metrics**

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Poster session P01, Economics of biodiversity

**Background and goal of study**

The global biodiversity and wilderness crisis is well described; it can be found across habitats, on land as well as in the oceans, in mountains, and on islands. The biodiversity status got specifically worse over the last 30 years, a time when relevant governments and institutions got occupied with the strong promotion of economic growth and neoclassic economy, and when globalization started.

**Materials and methods**

Using official U.S. National GDP data and the American Endangered Species (ESA) list, here I discuss the inherent conflict between economic growth and biodiversity.

## Results and discussion

Laws of Thermodynamics show that resources are limited, and that resource efficiency has actually increased consumption (Jeverson's Paradox) and contributed directly to biodiversity degradation. This pattern can be found in global endangered species lists, such as the ones of IUCN and NGOs. Second, using air quality and spatial human footprint data, I will discuss the failure of the environmental Kuznet's Curve, showing that an increase in wealth will not automatically result in an improvement of the environmental status of the globe due to the economies of scale.

**Conclusion**

A change in policy, institutional set-up, and culture is required to help to restore the environmental, social and economical situation and to achieve global sustainability.

**Keywords:** biodiversity crisis, economic growth, GDP, endangered species, policy

**Inwang Victoria, Nkang Ani, Udofia Udemé****Survey of mammalian fauna in stubbs creek forest reserve, akwa ibom state, Nigeria**

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Poster session P19, Systematics and taxonomy

This work presents the results of a survey of mammalian fauna in the Stubbs Creek Forest Reserve, Akwa Ibom, Nigeria. Stubb Creek (c. 80 km<sup>2</sup>) is one of the few remaining forest blocks in the Cross-Niger Transition Forests ecoregion of the Niger Delta. The area harbours several rare or threatened species, including the endemic Sclater's guenon (*Cercopithecus sclateri*). It is feared that human activities (including

gas flaring by oil companies) have caused massive migrations and extinctions of wildlife. The survey was aimed at identifying mammalian wildlife that is still present in the Stubbs' Creek area and not to provide detailed estimates of population density. Following reconnaissance trips undertaken in the area, five villages and local markets in the Stubbs Creek Forest area were selected for the survey. The survey employed study questionnaires, market surveys and oral interviews of natives, non-natives/settlers and visitors. Results revealed the presence of mammalian fauna such as Sclater's guenon, grasscutter, porcupine, ground squirrel, bush pig, fruitbat, rat, ottershrew, antelope, sitatunga, leopard, putty-nosed monkey, civet, blue duicker, pottos, hedge hog and rabbits. Elephants, bushpig, antelope, lion, gorilla and sitatunga are threatened or almost extinct. The tools used in hunting included traps (65%), guns (25%) and matchet (10%). The presence of the animals was not limited by season as they occur throughout the year. Wildlife resources, like forest resources, are renewable through good management practices. Sustainable development and conservation would help to avert ecological problems. The present study is important as it will enhance conservation awareness and provide a basis for the initiation of effective conservation management strategies.

**Keywords:** Wildlife, Survey, Forest, Nigeria, Threatened

### **Irissin-Mangata Josiane**

#### **Net-Biome: a regional biodiversity research coordination initiative**

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Poster session P08, Conservation planning

#### **Background and goal of the project**

Net-Biome, the first regional ERA-NET (FP6), aims at coordinating research and research policies in the field of sustainable biodiversity management in the tropical and subtropical European Overseas Territories and Regions, to develop a new approach for the coordination of local research priorities and networking the biodiversity research activities carried out for mutual benefit. It is composed of 11 partners which address together interests in biodiversity research activities, global change, and sustainable development, in most tropical and subtropical regions or territories of the E.U., namely France (La Réunion, Martinique, French Polynesia, New-Caledonia, French Guiana, Guadeloupe), Spain (Canary Islands), Portugal (Azores and Madeira), Netherlands (Netherlands Antilles), and the UK (UKOTCF).

#### **Materials and methods**

Mapping local priorities, research actors, facilities, and infrastructures of biodiversity research in close relationship with local actors will allow the identification of priority needs. Furthermore, it will explore opportunities for joint research activities and the mobilization of the necessary resources to a level not reached before, by strategically positioning the specific needs of Overseas Regions and Territories, both at European and international levels.

#### **Expected results and perspectives**

NET-BIOME provides an effective need-driven collaboration mechanism between outermost regions and territories, continental Europe and other countries, and establishes a common platform of coordination and cooperation among national and regional programmes and the development and implementation of joint activities. It is a focal point for support and European participation in large international programmes of global dimension in this domain. Net-Biome aims at stimulating new regional collaborations (neighbouring cooperation) in the Indian Ocean, the Pacific, the Atlantic and the Caribbean Ocean and at developing policy-support research activities.

**Keywords:** Global change, Sustainable management of biodiversity, science Policy interface, Tropical and sub-tropical European territories, Regional cooperation

### **Isabirye Brian**

#### **Soil texture as a determinant of environmental quality in the Mabira Forest ecosystems, Central Uganda**

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Poster session P16, Biodiversity indicators

The need for a soil survey to provide quantitative spatial distribution of soil properties for sustainable agricultural management has been emphasized. However, soil properties can be highly variable spatially and temporally, and measuring these properties is time consuming and expensive. Therefore, it is essential to derive relationships that link the basic soil properties to the functional soil properties that are more difficult to measure. This study determined the relationship between soil texture and soil quality (Chemical, organic, Physical, Fauna), vegetation quality, and general environmental quality in Mabira Forest and the surrounding environs. Ninety six random grid points covering the four major soil textural classes (Clay (C), Silt Clay (SL), Clay Loam (CL) and Silt Clay Loam (SCL)) were surveyed in order

to characterize the habitat types by describing the vegetation, belowground biodiversity and soil parameters, and their respective quality status evaluated. The results showed that Physical, Organic, Chemical and BGBD quality soil sub indicators were not significantly different ( $p < 0.05$ ) among the four classes. However, aboveground biodiversity quality (AGBD) was significantly different ( $p < 0.030$ ) among the four classes, with Clay (C) having the highest quality, followed by SL, SCL and CL. SCL was significantly different from CL, SL and CL and C and CL were also significantly different. The general quality of soil (GISQ), was significantly different ( $p < 0.032$ ) among the four classes, with SCL having the highest quality, followed by SL, Clay and CL. Post-hoc results showed that SCL was significantly different from CL, SL and CL and C and CL were also significantly different. Clay Loam texture was significantly associated with Chemical quality; Silt Clay Loam and Silt Loam were strongly correlated with GISQ, AGBD, BGBD qualities; while Clay texture was commensurate with physical quality. The study concludes that soil texture can be an appropriate predictor of vegetation quality and general environmental quality.

**Keywords:** Agriculture, Soil Texture, Soil Quality, Mabira Forest, Uganda

### **Ise Takeshi**, Moorcroft Paul

#### **Representing heterogeneity in species composition in space and time: Successional patterns on different soils in central Canadian boreal forests**

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Poster session P13, Analysing patterns and trends

#### **Background and goal of study**

Mechanisms that drive dynamics of forest species composition are an important study topic to understand processes that maintain regional biodiversity. We developed a process-based forest simulation model, Ecosystem Demography model (ED1) and applied it to the central Canadian boreal forests. Boreal landscape is highly heterogeneous due to temporal variation caused by frequent disturbance and spatial variation such as geomorphology. Therefore, the dynamics of tree species with distinctive ecophysiological characteristics were explicitly simulated on three substrate types varying in resource availability.

#### **Materials and methods**

We parameterized three representing tree species of this region: black spruce, jack pine, and trembling aspen to reproduce the succession dynamics. We simulated the forest successional patterns of these species on sandy, loamy, and organic soils with different levels of moisture and nutrient availability. Fire frequency was statistically calculated to model the temporal variation in stands.

#### **Results and discussion**

Due to differences in soil moisture retention and available nutrient concentrations, different patterns of successional dynamics were evolved. On sand, jack pine was the dominant species of early stages after disturbance due to its tolerance to water limitation. On loam, due to relatively high nutrient concentrations, trembling aspen, a resource-demanding broadleaf deciduous species, grew massively after disturbance. On nutrient-poor organic soil, the stress-tolerant black spruce became the dominant species. The simulated fire return intervals are 59 years, 76 years, and 127 years for sand, loam, and organic soil, respectively.

#### **Conclusions**

ED1 successfully reproduced different patterns of species composition dynamics originated from ecophysiology and local substrate conditions. Progress in simulation modelling will help manage and predict current and future biodiversity.

**Keywords:** drivers of biodiversity changes, boreal forest, forest species composition, simulation modelling, landscape heterogeneity

### **Jackson Louise**, Culman Steve, Young-Mathews Anna, Ferris Howard, O'geen Toby, Sánchez-Moreno Sara

#### **Plant and soil biodiversity in riparian corridors in an agricultural landscape**

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Poster session P03, Agrobiodiversity

#### **Background and goal of study**

Landscape approaches that integrate the relationships between biodiversity, agricultural production, and other ecosystem services improve information for land use decisions by farmers and other stakeholders. A participatory approach was used for studying a gradient of agricul-

tural intensification in a California watershed. The purpose was to examine the effects of riparian management and adjacent agricultural land use on the diversity of plants and soil biota, and the retention of nutrients and storage of carbon (C).

### Materials and methods

The project began by selecting sampling sites on farmers' fields using multivariate clustering techniques with GIS data for soils, vegetation, and land use. Then 60 points were inventoried for plants, nematodes, microbes (phospholipid fatty acid analysis), nutrients, and C storage along transects from waterways, and for riparian health. Farmers were interviewed about their management practices.

### Results and discussion

Land use had more significant effects on biodiversity and soil nutrient pools than the distance from a waterway. Healthy riparian zones harboured more diversity and more structured soil communities, but only occurred in a few places, mainly in the upland rangelands, in this highly disturbed landscape. Interestingly, high plant diversity was not associated with increased microbial and nematode diversity, possibly due to long-term disturbance and lack of remnant soil populations for recolonization. But, high plant diversity was a good indicator of ecosystem functions, e.g., carbon storage and nutrient retention.

### Conclusion

Restoration practices for riparian corridors clearly require sophisticated solutions with attention to existing site specific conditions, selection of well-adapted species and habitat construction methods. Farmer cooperation with NGOs is a successful method in overcoming these issues, and California's climate change policies may stimulate more effort in these directions.

**Keywords:** agricultural intensification, waterways, soil biota, vegetation diversity, carbon storage

## **Janse Jan**, Van Drecht Gerard, Weijters Maaïke, Westerbeek Paul, Biemans Hester, Alkemade Rob **GLOBIO-aquatic, a global model for the assessment of aquatic biodiversity**

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Poster session P12, Biodiversity and climate change

### Background and aim

Global biodiversity loss from aquatic ecosystems such as rivers, lakes and wetlands is a major concern. Major threats are: the alteration of natural catchments for human land use causing eutrophication, pollution and siltation; wetland conversion; habitat destruction and flow alteration caused by hydro-infrastructural works like dams; climate change; invasive species; and overexploitation. The aim of this study is the development of a global model, called GLOBIO-aquatic, of the combined effects of these factors on aquatic biodiversity. It complements the GLOBIO3 model for terrestrial ecosystems.

### Methods

The model framework combines an existing model of land use and climate change (IMAGE), an existing catchment network model, a global water flow model, a nutrients model for point and non-point sources, and several impact modules describing the relation between environmental drivers and biodiversity in rivers, lakes and wetlands. Most drivers are modelled (at present) at a spatial resolution of 0.5° (lat/long), and fluxes are accumulated downstream. The impact on biodiversity is based on a meta-analysis of literature data. Biodiversity is expressed as 'naturalness': the remaining abundance of native species, relative to the corresponding natural abundance, on a 0-1 scale. Simulations have been performed for the year 2000 and for several scenarios.

### Results and discussion

Habitat conversion and land use changes in catchments, as well as damming and use of water, result in a considerable loss of original species in downstream aquatic ecosystems of all types. The model results show that aquatic biodiversity has declined considerably in many parts of the world, and is expected to decline further in the future. Future developments of the model will comprise the integration of biological drivers like fisheries, and additional model validation.

### Conclusion

The model is a useful tool for global projections of aquatic biodiversity for combined scenarios.

**Keywords:** rivers, lakes, wetlands, eutrophication, water flow

**Janssen Thomas**, Marco Schmidt, Philippe Daget, Mipro Hien, Souleymane Konaté, Anne Mette Lykke, A. Mahamane, S. Porembski, B. Sambou, B. Sinsin, A. Thiombiano, B. Toutain, R. Wittig, G. Zizka

**Incentives for collaborative data pooling as a prerequisite for regional analyses of biodiversity dynamics: an example from West Africa**

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Poster session P04, Managing biodiversity with a social-ecological system focus

It is a common understanding that action needs to be taken quickly to preserve the natural resources of sub-Saharan Africa in the light of high anthropogenic and climatic pressures on habitats, fauna and flora. Research into the conservation and sustainable management of biodiversity is currently under way and depends on the availability of data with good spatio-temporal coverage. We used grasses (Poaceae) as a dominant component of sub-Saharan savannah ecosystems and analyzed the zonation of species occurrences together with the distribution of functional and photosynthetic types to illustrate the superior predictive power in modelling vegetation dynamics under climate change with regional data (sub-Saharan West Africa) as compared to local data (Burkina Faso). We argue that the acquisition of high quality data at a regional West African scale is too time- and cost-intensive to be achieved by a single team. Global access to an overview of existing data and ongoing projects is still not achieved, but is a prerequisite to concerted, time- and resource-efficient research and helps to avoid redundant data collection, promotes the closure of data gaps and fosters research synergies. We here present two online vegetation data platforms ("West African Plants" and "West African Vegetation") providing incentives to researchers and institutions to advertise and collaboratively use their research data whilst overcoming intellectual property (IPR) concerns.

**Keywords:** databases, IPR, Poaceae, sustainable management, vegetation dynamics

**Jansson Asa**

**Quantifying response diversity for building resilience in urban landscapes: upholding pollination potential for food security**

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Poster session P18, Managing for ecosystem services

**Background and goal of study**

The majority of humans live in urban areas, depending on a wide range of benefits from nature for their welfare and survival. Due to growing pressure on and demand for land for urban growth, it is essential to include the generation of ecosystem services into urban development and management. The informal production of food in urban areas is a widespread strategy adopted by urban dwellers. A challenge is to maintain the ability of urban landscapes to generate food during times of change. The significance of the functional aspects of biodiversity for the generation of ecosystem services has been established. However, in times of change, sustaining diversity within functional groups is also crucial. This aspect of biodiversity, response diversity, has been far less investigated, especially in a sustainable urban landscape management context and it is a critical element in building resilience.

**Method**

The effect of urban development on the pollination potential for food production was investigated through the use of a GIS on an urban landscape scale. The difference in the scale of operation of different pollinators in a functional group was used as a proxy for response diversity.

**Results and discussion**

The results show that pollinators within the same functional group, but differing in response diversity, react differently when exposed to urban land use change. The predicted change generate a 1.8% drop in pollination potential when treating the functional group as one, with an average scale of operation of 750 m, while a 4.3% drop was observed when investigating a sub pollinator group with a scale of operation differing from the average. A difference in resilience for the pollination service was thus observed when including response diversity.

**Conclusion**

The spatial scale aspect of response diversity needs to be addressed if aspiring to maintain resilience for building food security in urban landscapes in a sustainable urban development context.

**Keywords:** response diversity, resilience, ecosystem services, pollination, spatial urban landscape planning

**Joly Carlos A.**, Assis Marco A., Bernacci Luis C., Tamashiro Jorge Y., Torres R.B., Pedroni Fernando, Lacerda M.S., Aboin-Gomes José Ataliba, Prata E.M.B, Rochelle A., Campos M.C.R., Ramos E., Pereira L.S., Padgurschi M.C., Alves L.F., Vieira S.A., Martins F.R., Santos F.A.M.

**The Brazilian atlantic rain forest: structure, composition, and functioning at the Serra do Mar State Park**

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Poster session P17, Monitoring biodiversity

In the present study, forest structure and composition were evaluated across different Atlantic Rain Forest physiognomies in SE Brazil: Lowland Ombrophylus Dense Forest, Submontane ODF, and Montane ODF. All trees with DBH  $\geq$  5 cm were sampled in 14 1ha permanent plots established along an altitudinal gradient (0 to 1,100m a.s.l.). In order to have replicates, a set of four 1 ha independent plots was established in each forest type. Two additional plots were included as representatives of other forest types along the gradient: Restinga Forest (seasonally flooded forest on sandy soils of the Coastal Plain) and a Lowland ODF logged 40/45 years ago.

On average, we sampled 1500 stems/ha, resulting in 21,000 stems distributed in different life forms: trees (85%), palms (14%), and tree ferns (1%). Species richness increased along the gradient from 90 species/ha in the Restinga up to 130 spp in the Lowland (50–100 m) and in the Montane ODF (500-1,100 m). However, the highest number of species was found in the Submontane ODF (100-500 m), with more than 200 spp/ha. Myrtaceae (35 spp/30 spp), Rubiaceae (20/15), Fabaceae (19/18) showed the highest number of species in the Lowland ODF & Submontane ODF. Lauraceae, Euphorbiaceae and Monimiaceae become important in the Montane ODF, where the presence of bamboo thickets is conspicuous. In all forest types along the gradient, the palm *Euterpe edulis* is the most important species, whereas *Alsophila* and *Cyathea* are the most important genus of tree ferns.

Our results suggest that the Brazilian Atlantic Forest is different from the Brazilian Amazon Forest in terms of canopy height (18-20 m), height-diameter relationships, tree density and species diversity. The average basal area for stems (31,5 m<sup>2</sup>/ha) is among the range of values reported for other Neotropical forests, but stem density is higher than Terra Firme Forests in Amazon and Central America, probably due to the inclusion of palms and tree ferns in our study.

**Keywords:** Neotropical, Hotspot, Biodiversity, Mountain, BIOTA, FAPESP

Joly Helene, Garine Eric, Deu Monique, Mckey Doyle, Trigueros Ghislain, **Barnaud Adeline**

**The dynamics of sorghum genetic diversity in a traditional farming system**

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Poster session P03, Agrobiodiversity

Understanding the dynamics of crop genetics diversity is central for managing agricultural systems and conserving genetic resources. Although many aspects of the processes, particularly the relative role of mating systems and the human choice of facilitating or constraining gene flow among landraces, are still poorly understood. We developed an interdisciplinary approach, involving both biologists and social scientists, to investigate the dynamics of genetic diversity of sorghum landraces at the scale of a village in northern Cameroon.

Duupa farmers managed more than 40 landraces which are grown mixed in field (4 to 11 landraces per field). We investigated the pattern of landraces genetic diversity, the extent of pollen flow, and its links with farming practices. We first characterized 21 landraces using SSR markers. We then estimated parameters of the mating system of five landraces using a direct method based on progeny array. Our genetical results are interpreted in the light of data on farmers' knowledge and on practices such as the spatial pattern of planting and the selection exerted by farmers.

Analysis grouped the 21 landraces studied into four clusters. These clusters correspond to functionally and ecologically distinct groups of landraces. Outcrossing rates varied greatly among landraces, from 5% to 40%. Our results show that both natural and human-mediated factors shape sorghum genetic diversity. While the biological traits of sorghum and the spatial planting practices of Duupa farmers lead to extensive pollen flow among landraces, the selection exerted by farmers appears to be a key parameter affecting the fate of new genetic combinations from outcrossing events. Therefore designing in situ conservation measures requires that biologists and anthropologists work together.

**Keywords:** agrobiodiversity, microsatellites, farmer's practices, Sorghum bicolor, gene flow

**Joshi Pawan Kumar, Dash Pushpa****Biodiversity characterization at landscape level using geospatial tools and other inputs – an Indian perspective**

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Poster session P13, Analysing patterns and trends

The geospatial presentation of habitat status is a key issue for conservation planning and management. Biodiversity characters of the habitat are the basis of prioritizing conservation sites. Because of India being one of the mega biodiversity countries in the world, the task is of greater significance. This paper presents an approach for biodiversity characterization at the landscape level, using a three-tier approach, viz., satellite data processing, field data, and a landscape analysis.

IRS LISS III data has been used for the characterization of the landscape and the stratification of the ground inventory. This is used to spatially model the spatial characters of the landscape to identify disturbance regimes and spatial pattern of biological richness. Landscape metrics (viz. patch shape, size, number, porosity, fragmentation, interspersion, juxtaposition) and socio-economic interferences have been spatially analyzed to present the disturbance regimes. Field survey attributes on species diversity, economical/medicinal uses, ecological significance and endemism were linked with satellite image derived landscape attributes in a GIS environment. The biological richness is estimated as a function of six biodiversity attributes (i.e., spatial, phytosociological, social, physical, economical and ecological) to stratify the habitat using customized software, SPLAM.

In India, habitat fragmentation and degradation have been identified as fundamental reasons for biodiversity loss. Anthropogenic activities viz., shifting cultivation, mining, industrialisation, and clearing for resource extraction are the main causes of habitat fragmentation and destruction. The tribal population's interaction with the forest is a congregation to the goals of conservation in many parts of country. This approach for prioritizing biodiversity rich sites has the advantage of integrating spatial and non-spatial information, and horizontal and vertical relationships. This will facilitate conservation prioritization, the systematic inventory and monitoring.

**Keywords:** Biodiversity, disturbance, fragmentation, landscape ecology, remote sensing

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Poster session P08, Conservation planning

The study assessed the impact of *Lantana camara*(L) invasion on native vegetation in Northern part of Gonarezhou National Park (GNP), Zimbabwe. Stratified random sampling was used with three categories; uninvaded, moderately invaded and heavily invaded. The distribution of *L. camara* in Northern Gonarezhou National Park was mapped using GIS. Vegetation attributes measured for native vegetation were; basal area, canopy cover, herbaceous cover, and woody plant density. Species diversity ( $H'$ ) and species richness ( $S$ ) were determined in each category. *L. camara* was mainly distributed within the riparian vegetation and in the low-lying areas of Northern GNP. A total of 41 native woody species and native herbaceous species were identified in the study area. For 72 native vegetation attributes; basal area, canopy cover, herbaceous cover, woody plant density, species diversity ( $H'$ ) and species richness ( $S$ ) varied significantly ( $P < 0.05$ ) among the categories of *L. camara* intensity. These variables were highest in the uninvaded category and lowest in the heavily invaded category. The uninvaded category was the most diverse ( $H' = 1.875$ ) while the heavily invaded category was the least diverse ( $H' = 1.334$ ). The significant difference in vegetation variables suggest that *L. camara* is altering native vegetation structure and composition in GNP to the detriment of wildlife management. Active management of *L. camara* in Gonarezhou National Park is therefore urgently required for wildlife and biodiversity conservation in the area.

**Keywords :** Alien plants, Invasive plants, SAVI model, Vegetation composition, Biodiversity

**Karamhudoeva Munira, Van Oudenhoven Frederik****The impact of climate change on pest damage to subsistence agriculture in the Pamir Mountains, Tajikistan**

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Poster session P03, Agrobiodiversity

The Western Pamirs are a remote mountain region in the South of Tajikistan. Due to its harsh and varied environment, and many centuries of active crop selection and domestication by farmers, the region is rich in agrobiodiversity and crops are well-adapted to the caprices of their surroundings. Nonetheless, Pamiri agriculture is vulnerable to climatic changes, and so are the livelihoods of the majority of the people that depend on it.

As in other mountainous regions of the world, the effects of climate change in the Pamirs are relatively pronounced, with warming winters, decreasing snow fall, and increasingly unpredictable changes of seasons. The negative consequences that further changes are likely to have on ecosystem and agricultural productivity, lend particular urgency to the study of these effects and to the development of suitable

adaptation strategies for farmers. Over many years, the Pamir Biological Institute has conducted studies into the phenology of agricultural pest insects and their impact on agricultural production. We investigated insect and plant behaviour along an elevation gradient to simulate future climate patterns and to determine their relative capacity for adaptation to these changing patterns. We observed a high ability of the majority of 67 identified species of insect pests to adapt to probable future climate conditions and a much lower speed of adaptation of plants, suggesting potentially devastating future increases in pest damage to crops. Several options for mitigating such impacts were identified. First, natural predators are effective in reducing pest insects and can be employed in pest control. Second, a liquid mixture of local alpine plants with insecticidal properties was developed, which can be prepared easily by farmers and kills up to 95% of insects. Lastly, pest incidence on farms with high crop diversity was lower than on farms with less diversity, suggesting an important role for local agrobiodiversity in adapting to climate change.

**Keywords:** Western Pamirs, mountain agriculture, insect pests, climate change, agrobiodiversity

### **Kasangaki Aventino, Chapman Lauren**

#### **Land use effects on stream water quality in and around Kibale National Park, Uganda**

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Poster session P05, Drivers of biodiversity

Human activities outside protected areas have compromised the quality of ecosystem services streams and rivers provide to the local communities. Here we report on a study that investigated patterns of stream macroinvertebrate community structure and water quality variables along a gradient of tropical moist high forest to agricultural land outside the Kibale National Park, mid-Western Uganda. Results reveal a gradient in water quality (based on a suite of indicators) from poor in agricultural areas to better in remnant swamps and forested streams outside the park, to good inside the national park. High water conductivity, high water temperature, and low dissolved oxygen characterized sites in agricultural areas. Tolerant invertebrate taxa such as mollusks dominated agricultural stream sites while sensitive taxa of mayflies and caddisflies dominated forested sites. The findings have important health implications for the communities and their livestock that depend on the streams for their water sources. Efforts should be made to conserve the remaining natural habitats and to restore degraded streams outside protected areas if the ecosystem services that these streams provide are to be maintained. There is an urgent need for government departments such as agriculture, water resources, and environment to work together in formulating policies that allow development without compromising the quality and quantity of freshwater resources. Rural communities need to be engaged for example through awareness programs about the value of maintaining streams and rivers in a healthy state as degraded streams have direct impacts on people's health.

**Keywords:** Bioindicators, degradation, ecosystem services, streams, water quality

### **Kaushal K K**

#### **Village Forest Councils: Emerging rural institutions for conservation and development in Tamilnadu state of India**

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Poster session P11, Conservation, conflicts resolution and development

Tamilnadu, a Southern state of India, has embarked upon a community involvement process to restock its forests through an Indian version of community forestry called Joint Forest Management. The Tamilnadu Forestry Project, funded with US\$200 million by the Japan Bank for International Cooperation, was launched in 1997–1998 in this state of India and has evolved into a comprehensive poverty alleviation programme for the forest abutting villages where the proportion of poor people is the largest. People's participation is structured through specially established local representative institutions called Village Forest Councils (VFCs). This article seeks to present a full account of the concept, working and effectiveness of the VFCs in Tamilnadu. Based on the author's field experience as District Forest Officer working with the JFM program, it further suggests that VFCs are evolving into important local institutions for empowerment, poverty alleviation and social development of forest communities. VFCs are emerging as important and vital tiers of the local self government. The entire planning, execution and monitoring of the programme is done by the VFCs, whose day to day affairs are looked after by its executive committee headed by the elected president. The annual NTFP revenue for some of the VFCs has already crossed US \$ 4000 and from the initial money of US \$ 12000 for the buffer zone, some VFCs have developed a corpus fund of US \$ 24000 for a microcredit as they are charging an interest rate of one percent per month from the beneficiaries. The VFCs control not only all the forest affairs and the involvement of line departments, but also serve as a forum for forest people to evolve a common strategy and wield collective bargaining power for assembly and parliamentary elections.

But the VFCs plan and execute guidelines within the project, which restrict their flexibility to address local issues fully.

**Keywords:** Joint Forest Management, Village Forest Councils, rural institutions, conservation, development

**Kawabata Zen'ichiro****Destruction of littoral zone, koi herpesvirus, and human linkages: A case study of Lake Biwa, Japan**

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Poster session P09, Global environmental change and health

**Background and goal of study**

The rapid spread of emerging infectious diseases is becoming a serious global environmental problem. To predict and prevent outbreaks of infectious diseases, it is essential to understand the interactions among environments pathogens, and humans, as well as to conduct pathological studies. Our hypothesis to be tested is that environmental alterations by humans mediate the spread of disease.

**Materials and methods:** Destructed littoral area of lake by humans - koi herpesvirus(KHV)-carp (*Cyprinus carpio carpio*) - human linkages were analyzed as a case study. No studies relevant to verify the linkages has been existed, due to several reasons; these are less urgent issues, insufficient methodology, difficulty of verification of the causes and effects in the linkage, and comprehensive research involving different levels of systems, ranging from molecular biology to human society.

**Results and Discussions:** We established the detection method of KHV in natural waters. Using our method, it was revealed firstly in the world that KHV lasted existing in the both lakes and rivers for a long period after KHV. Spatial and temporal changes in water temperature in human degraded littoral zone were more homogenous than those in natural ones. Changes in water temperature possibly affect carp behavior, carp immune against KHV, stress of carp. It was also found carp bigger than 30 cm in length had immune against KHV indicating that behavior of different size of carp is a key factor to know spreading process of KHV disease. We establish a method to quantify a stress substance in water to know the relationship between water temperature and stress in carp. We tried to integrate these new findings to verify the hypothesis.

**Keywords:** Littoral zone, Koi-herpesvirus, Carp, Human activities, Linkage

**Kent Rafi, Carmel Yohay****Bio-environmental surrogates for biodiversity**

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Poster session P17, Monitoring biodiversity

**Background and goal of study**

Using surrogates for biodiversity has become a prevalent practice in conservation decision making. Two types of surrogates exist, environmental and biological. It was suggested that hybridization of the two surrogate types would outperform any single type of surrogate, but no such hybridization has been constructed before. Here, we constructed three different prototypes of hybrid bio-environmental surrogates, and compared their performance to single-source surrogates.

**Materials and methods**

The study took place in Mt. Carmel, Israel. Distribution data on 23 geophytes and 37 woody plants were included in the analysis, as well as eight environmental parameters related to climate, soil, and topography. We used a cluster analysis of environmental parameters to partition the area into land parcels with similar environmental traits, and of distribution data to identify areas with similar species composition.

**Results and discussion**

All three hybrid surrogates represented more species than any single-source set, pointing to a probable superiority of hybrid surrogates. Species niches are determined by environmental conditions, and by intra-specific interactions. We propose that the same is true for species assemblages, thus using information on the spatial distribution of both, results in high accuracy of true biodiversity representation through surrogacy.

**Keywords:** Ecological niche, Conservation planning, Cluster analysis, Mt. Carmel, Coarse-filter

**Khattabi Abdellatif**, Amini Taoufik, Ezahiri Moustafa**The sensitivity of wetlands habitats to sea level rise**

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Poster session P12, Biodiversity and climate change

**Background**

The project ACCMA is funded by the International Development Research Center (IDRC) and the Department of Foreign International Development (DFID) under the program Climate Change Adaptation in Africa (CCAA), and it is implemented by an international consortium in the Eastern Mediterranean Coast of Morocco (EMCM) which holds three Ramsar sites, one of which is the lagoon of Nador considered as one of the largest lagoons of the Mediterranean coast. The ACCMA project aims to reduce the vulnerability of coastal communities and natural ecosystems to the impacts of sea level rise, coastal flooding, and related extreme weather events in four pilot sites including the lagoon of Nador.

**Materials and methods**

The area surrounding this lagoon contains sandy beaches, natural wetlands, urban and rural settlements, harbours, and road infrastructure. The area is at risk from the impacts of climate change and sea level rise because of its low level topography. The objectives of the project are achieved through synthesizing the evidence and methods of the impact assessment from different disciplinary areas, developing them into a unified framework for analysing the ecological, economic, and social consequences of different forms of climate change impacts. The global objective is pursued through assessing population, natural, and socioeconomic vulnerability to climate change impacts, and developing adaptation strategies and local capacity for multi-stakeholder, participatory policy and planning processes.

**Results and discussion**

This article describes the wetlands ecosystems in the study area by proceeding through vegetation groupings and evaluating the sensitivity and vulnerability of the natural habitats to potential impacts resulting from sea level rise. The sensitivity was determined by taking into account the intrinsic values of the ecosystem in terms of endemic, rare and endangered species, and the vulnerability was defined by the degree of exposure to the climate impact risk and the magnitude of the natural habitats sensitivity.

**Keywords:** Habitats sensitivity, climate change impacts, Mediterranean coastal zones, vulnerability adaptation to climate change impacts, wetlands of international importance

**Khumalo Sibonginkosi**, Hodgkin Toby, Ndung'u-Skilton Julia**Enhancing the sustainable use and conservation of agrobiodiversity for human needs through collaborative research and information sharing**

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Poster session P03, Agrobiodiversity

Agrobiodiversity is of fundamental importance to human livelihoods and contributes significantly to food security. The full potential of agrobiodiversity has remained unrealized, and many of these resources remain underutilized. Agroecosystems are becoming increasingly simplified and vulnerable with the loss of trees, hedgerows, soil organisms, pollinators and species that help control pests and diseases. Many useful wild species found in and near these systems are also threatened. The problem is most acute in developing countries, where farmers lack the means to cope with market shifts, climate change or new disease threats. If agrobiodiversity is optimally managed and sustainably used, it will provide significant means of addressing food insecurity, malnutrition, poverty and environmental sustainability. The Fifth Conference of the Parties to the Convention on Biological Diversity highlighted the lack of understanding of the magnitude, causes and consequences of the loss of agrobiodiversity. It also stressed the gaps in knowledge regarding the benefits of high levels of agrobiodiversity and management practices that can help increase agricultural sustainability and productivity. Improved ways and concerted global efforts are thus required to maintain and make the best use of agrobiodiversity, and to help farmers meet their diverse needs. The Platform for Agrobiodiversity Research is an independent entity, established in 2006, to provide a framework for interaction and collaboration between stakeholders working in agrobiodiversity research. The overall goal of the Platform is to enhance the sustainable management and use of agrobiodiversity by improving knowledge on all its different aspects, by fostering communication, and contributing to the development of research programmes by providing information, linking experts and organizations and advocating for collaborative research programmes.

**Keywords:** agrobiodiversity, conservation, collaboration, research, information

**Konaté Souleymane**, Linsenmair K. Eduard

**Diversity and role of termites in West African savannahs: case studies in Burkina Faso and Côte d'Ivoire**

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Poster session P07, Biodiversity and ecosystem functioning

African savannahs are important and much extended ecosystems of great significance for biodiversity and as an economic area for humans. Termites represent a very important component of soil biodiversity in West African savannahs, delivering essential ecosystem services (by e.g. improving soil water content, soil fertility and carbon sequestration). This study aims to analyse the diversity and functional roles of the termites along a climatic and anthropogenic use gradient in West African savannahs, with two case studies in Burkina Faso and Côte d'Ivoire. A rapid assessment protocol of biodiversity, based on standardized transects, was used to record the termite diversity. Termite biogenic structures and physico-chemical soil properties were analysed to assess their influence on soil water and nutrient dynamics. Termite species richness and functional diversity broadly decrease with increasing aridity (from moist savannahs to dry savannahs) and with land use intensification. Fungus growing termites of the genus *Odontotermes* play a key role as ecosystem engineers, in the dry as well as in the moist savannahs where they strongly influence the vegetation structure and dynamic. This they achieve in first line by modifying soil physico-chemical properties and soil water content. In conclusion, in West African savannahs, the diversity of termites changes with the amount of rainfall. Fungus growing termites are playing a key role in maintaining soil fertility and perform some essential ecosystem services like carbon sequestration (in moist savannahs) and soil restoration (in arid savannahs). This is well illustrated in a West African traditional practice, the Zaï system, which can be considered as a true model of ecological engineering for soil restoration based on the activities of termites.

**Keywords:** biodiversity, soil, termites, savannas, West Africa

Krause Michael, Lotze-Campen Hermann, Popp Alexander, Vohland Katrin, **Cramer Wolfgang**

**Implications of biodiversity conservation areas on spatially-explicit available land for global cropland expansion in an integrated land use modelling framework**

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Poster session P08, Conservation planning

**Background and goal of the study**

Several global land use studies assess trade-offs between competing land uses by making environmental, policy, and economic assumptions on the availability of land. High opportunity costs of cropland expansion into areas providing ecosystem services, e.g. high biodiversity, are assumed and restrict the available land pool. There is need to quantify opportunity costs in a consistent land use budgeting approach over time and to focus on temporally-dynamic trade-offs between cropland expansion and land reserved for biodiversity conservation. Thus, we strive for (a) integrating datasets on forest cover for biodiversity conservation and protected areas in consistent land use datasets and (b) analysing the impacts of restricted cropland expansion on global food production and opportunity costs of restriction.

**Materials and methods**

A static rule-based geographical approach helps to integrate climate, physical and normative constraints in consistent spatially-explicit land use datasets. Emphasis is put on a global biodiversity conservation priority template focusing large-scale intact forest landscapes which is complemented by IUCN protected areas. Data integration outputs define the conservation scenario and contrasting baseline by making use of historical cropland conversion rates. Cost-minimized food production is achieved by trading off costs for land expansion versus technological change if needed. The opportunity costs of restricted cropland expansion are defined as the foregone production cost reduction indicating the value of land for biodiversity conservation.

**Results, discussion and conclusions**

Results, discussion and conclusions will refer to the total cost of global food production and the opportunity costs of restricted land expansion, the spatial patterns of cropland and available land with and without conservation constraints. Associated shadow prices for land, and the role of technological change will not be unveiled until 2055.

**Keywords:** biodiversity conservation, protected areas, cropland expansion, available land, spatially-explicit modelling

**Kristensen Maria Julia**, Vazquez Patricia, Leber Virginia Andrea, Lavornia Juan Manuel, Salle Analia, Higuera Mariela

**Biodiversity conservation aspects in Austral Pampean ecosystems (Tandil, Buenos Aires, Argentina)**

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Poster session P08, Conservation planning

The conservation of biodiversity requires sustainable management of land and natural resources. In this sense, the knowledge of the structure and function of ecosystems is the key. In the plains of Buenos Aires, the native grasslands alternate with ponds and lakes. In the coastal dunes areas the vegetation is scarce. The value of biodiversity is moderate, with a low regional endemism, and high singularity. It is the area with greater degradation in Argentina and an area where a high conservation effort is urgent, but it is not much what has been done.

This project contributes to the knowledge of biodiversity and ecosystem of pampa–mountain systems, agroecosystems and coastal dunes - with the purpose of offering guidelines for conservation and sustainable use. Aims are: (1) An evaluation of the biological invasions in the mountain System of Tandilia. (2) An assessment of the estate of conservation of grasslands and coastal ecosystems in Natural Reserves. (3) Assessing the fire and grazing over natural grasslands. (4) Identifying sustainability indicators in agroecosystems. (5) Using bioindicators to assess water quality of streams (diatoms and benthic macroinvertebrates) and air quality (saxicolous lichens). (6) Assessing wildlife resources based on cynegetic activity and fern recollection. (7) Evaluating the use of medicinal native flora.

We detected the presence of invasive woody plants that reduce the richness of birds of grasslands. In coastal dunes, the index of relative vulnerability showed that there are vulnerable species of reptiles, amphibians and mammals. In agroecosystems no till farming increased negative environmental impacts: 3.6 times the wastes and 14 times the dangerous substances (agrochemicals). The sustainability and biotic index must be modified to adapt them to the study area. Wildlife resources are sometimes used without regulation and control, and their management is not sustainable. The legislation is not adjusted to resources characteristics.

**Keywords:** Relictual grasslands, water and air pollution bioindicators, agroecosystems, wildlife resources, coastal dunes

**Krug Cornelia B.**

**Developing frameworks for the conservation of biodiversity and ecosystem processes in a fragmented landscape: integrating and implementing ecological research**

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Poster session P02, Biodiversity science and policy

**Background**

The lowland vegetation types of the Cape Floristic Region (CFR) are highly transformed and fragmented due to agricultural conversion and urbanisation, with pressure continuing on natural environments. Conservation plans guide land use planning and conservation management, which require specific inputs to be effective. Although research into the effects of habitat fragmentation on biological diversity and ecological processes is being conducted and results are available, this information is often not readily accessible for conservation managers and spatial planners, cannot be translated directly into management guidelines, and is not adequate to inform conservation planning and decision-making.

**Materials and methods**

Fragmentation effects on a range of taxa (plants, insects, birds, small mammals) were investigated in a number of fragments across the CFR. At the same time, workshops with various stakeholders were conducted to determine their needs, and to identify “burning questions” that need answers from ecological research.

**Results and Discussion**

Responses to fragmentation vary considerably between taxonomic groups, and are often confounded by management effects, patch disturbances and variation in habitat parameters. This also affects ecological processes and ecosystem function at different scales. Nevertheless, some indicator species / guilds could be identified that can assist in monitoring conservation and management actions. The workshops identified the need for two decision-making frameworks, one on fragment ecosystem health and one on landscape management, which are being populated with research results and information from expert interviews, and are made accessible through a decision-support system. Furthermore, information on appropriate management strategies and guidelines for conservation of biodiversity and ecological processes across the landscape arising from the project are being disseminated to relevant authorities and stakeholders.

**Keywords:** habitat fragmentation, biodiversity pattern, ecological processes, research implementation, decision-making framework

**Laird Megan**, Griffiths Charles

**The biogeography and biodiversity of sea anemones in South Africa**

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Poster session P13, Analysing patterns and trends

Many South African marine invertebrate taxa are reasonably well documented. However, the sea anemone fauna has been poorly studied. There are forty-nine anemone species known in South Africa. Of these, thirteen are found on the West coast, twenty on the East coast and sixteen species are found all around the South African coastline. Forty-nine per cent of the South African sea anemone species are endemic. Not much is known about the distribution of South African sea anemones and there are no updated, comprehensive keys for most of the species. Thus, I aim to produce a taxonomic key, as well as a field guide for South African sea anemones; which can aid both scientists and the general public in identifying sea anemones to species level. I will also address some of the taxonomic issues that exist within the order Actiniaria. The species that I will focus on include: *Anthothoe chilensis*, *Pseudactinia flagellifera*, *Pseudactinia varia*, *Anthopleura michaelsoni*, *Anthopleura aneae* and *Anthopleura insignis*. Histology and genetic techniques will be used to determine whether different colour morphs of each species are genetically different. This study will greatly enhance the knowledge about sea anemones in South Africa and will address some of the existing taxonomic issues.

**Keywords:** Actiniaria, Biodiversity, Biogeography, Taxonomy, Sea anemones

**Lamarque Pénélope**, Lavorel Sandra, Grigulis Karl, Colace Marie-Pascale, Lembke Manuel

**Determinants of spatial distribution of ecosystem services hotspots provided by mountain grasslands**

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Poster session P18, Managing for ecosystem services

**Background and goals of study**

In European mountains, the biodiversity of grasslands has been determined by numerous centuries of agricultural use. Multiple services provided by these agroecosystems are valued beyond fodder production. Today, the political and socio-economical context makes this multifunctionality a potential asset for these fragile systems. Therefore, understanding how human actions and other drivers affect the provision and the spatial distribution of multiple ecosystem services is a priority.

**Materials and methods**

Using ecological (including plant functional traits), biophysical and land-use data, we analysed the determinants of the spatial distribution of biodiversity and ecosystem services within the landscape of Villar d'Arène (France). The methodology is based on statistical and geographical information systems modelling. We analysed the relative roles of abiotic and land use factors on the distribution of individual services. Resulting service maps were combined to locate hot (many valued services) and cold (low value for the majority of services) spots for multifunctionality. Based on these results, we identify tradeoffs and synergies among different services.

**Results and discussion**

This method based on plant traits provides a mechanistic view into dynamics of multiple services. Land use history appears from this analysis as a major factor controlling the provision of multiple services by mountain grasslands. Mapping multiple ecosystem services and analysing their interactions (tradeoffs, synergies or independence) at a landscape scale are key to highlighting future management priorities, but also to demonstrate that in some cases both conservation and production objectives can be achieved together.

**Conclusion**

This study shows the importance of coupling several variables like ecological (plant function traits) and human actions (land use history) to quantify and analyse the services provided by grasslands.

**Keywords:** Multiple ecosystem services, Hotspots mapping, Land-use, Plant functional traits, Mountain grasslands

**Lange Louise**, Griffiths Charles L.

**Biodiversity and biogeography of benthic marine invertebrates in South Africa**

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Poster session P13, Analysing patterns and trends

**Background and goals**

Our state of knowledge of the benthic invertebrate biodiversity over the continental shelf surrounding South Africa is extremely poor. This study aims to determine patterns of benthic invertebrate biodiversity and biogeography in this poorly known environment based on standard, quantitative sampling methods.

**Materials and methods**

Over 300 standardised experimental trawls samples were taken along the South and West coasts of South Africa during 2007 and 2008, arranged in a randomly stratified grid ranging in depth between 30 m and 600 m. All invertebrates caught in the by-catch were separated, counted, weighed and identified.

**Results and discussion**

The Indian Ocean coast or South coast supports a wide variety of benthic invertebrates, approximately 300 species, with echinoderms (35 %), anomurans (20 %), hydrozoans (16%) and opisthobranchs (10 %) constituting the highest biomass in this region. On the West coast, the cold Atlantic Ocean supports a much lower benthic biodiversity, in the region of a 140 species, with sponges (82 %) being the most important contributor to the overall biomass. Anomurans (7 %) and macrurans (4 %) were the second and third highest contributors to biomass in this cold region. Bray-Curtis similarity analyses are used to visually represent benthic community patterns and SIMPER analysis used to identify which species are the most important determinants of these patterns. Physico-chemical parameters are also overlain on these patterns to determine how they relate to the biotic patterns. These analyses are still underway but results will be available and presented at the conference.

**Keywords:** marine, invertebrate, benthos, biogeography, South Africa

**Larsen Frank W**, Turner Will, Brooks Thomas

**Protecting the alliance for zero extinction, global biodiversity conservation sites will also provide valuable human well-being benefits**

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Poster session P18, Managing for ecosystem services

**Background and goal of study**

Efforts to conserve biodiversity can also ensure the provision of valuable ecosystem services important for human well-being, and thereby provide further conservation incentives and funding for conservation. However, the human well-being benefits of protecting priority areas for biodiversity conservation remain poorly understood. In this study, we use the Alliance for Zero Extinction (AZE) sites to explore some human well-being benefits of biodiversity conservation at the site scale.

**Materials and methods**

We compare the ecosystem service value of the global set of conservation priority sites to null models to assess their relative value. We assess 1) carbon emissions avoided (based on a global map of C stores, deforestation rates and plausible Reduced Emissions from Deforestation and Degradation mechanisms), 2) hydrological services (based on global modelling of flows, runoff, and demand for clean and abundant water), and 3) cultural value (based on data on linguistic diversity). We also assess the added biodiversity value of these sites (based on global species data on birds, amphibians, mammals, and turtles).

**Results and discussion**

Overall, we find that the AZE sites provide a disproportionate share of ecosystem services. For example, the high carbon storage of an AZE forest (122 t C/ha) compared to overall forests in the same ecoregions (101 t C/ha), combined with high deforestation rates, make the AZE sites relatively important for climate change mitigation. Although results vary by service and region, conserving sites of global biodiversity importance will also provide considerable additional human well being benefits.

**Conclusion**

We find that there are considerable human well being benefits associated with conserving the global set of priority sites that hold one or more species in imminent danger of disappearing.

**Keywords:** Global priority areas, biodiversity, ecosystem services, hydrological services, conservation

**Le Maitre David, O'Farrell Patrick****Assessing hydrological ecosystem services in the Succulent Karoo: biodiversity, variability, scarcity, and vulnerability**

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Poster session P18, Managing for ecosystem services

**Background**

The Succulent Karoo is an exceptionally species-rich desert region and a global biodiversity hotspot. This paper reports on a spatial assessment of its ecosystem services and how their protection could contribute to biodiversity conservation. The evaluation focuses on hydrological ecosystem services: water flows and quality and links to land productivity.

**Results**

Flows of water are a key determinant of patterns of biological diversity and productivity, and, thus the benefits provided to society. Rainfall, soil moisture, and soil fertility determine the productivity of the rangelands which support extensive livestock farming in this area. Both surface and ground water in the Succulent Karoo are very limited, highly variable in space and time, and frequently of poor quality. Water scarcity has a significant impact on human well-being and development options. Conventional assessments do not account for the scarcity of water and human vulnerability to its variability in space and time. But water scarcity is a characteristic feature of the area and it will increase significantly given the current climate change scenarios. Historical inequities in access to water and other resources have significant implications for economic development and human well-being. Increasing human pressure on the already degraded natural resources could lead to further declines in biodiversity and land productivity and exacerbate changes in water quality and flows.

**Conclusion**

The central challenge facing the people of the region is the management of its resources – water, soil, biodiversity - for equitable, sustainable, and efficient use. An integrated approach to natural resource management, underpinned by a sound land ethic, is needed to ensure that development strategies take account of the finite and vulnerable nature of the biodiversity and ecosystem services that underpin human well-being in the Succulent Karoo, particularly the scarcity and variability of water resources.

**Keywords:** ecosystem services, water, scarcity, sustainability, sustainability

**Locatelli Bruno, Imbach Pablo, Laumonier Yves****Are biological corridors helping ecosystems to adapt to climate change in Mesoamerica?**

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Poster session P18, Managing for ecosystem services

**Background and goal of study**

Climate change will modify the spatial distribution of ecosystems. Even though the future distribution of ecosystems depends on the ability of plants to migrate, most biogeography studies related to climate change consider unlimited migration ability or no migration. As migration is limited by the fragmentation of landscapes through which species could disperse, the establishment of corridors may facilitate the adaptation of ecosystems to climate change. This study aims at assessing the contribution of biological corridors to the adaptation of protected areas to climate change in Mesoamerica.

**Materials and methods**

We developed a model representing ecosystem migration in a fragmented landscape under scenarios of climate change. This model is implemented with cellular automata and applied to the Mesoamerican landscape with different scenarios of fragmentation around protected areas or connectivity enhancement by the Mesoamerican Biological Corridor. The model estimates the effects of corridors on the adaptation of protected areas. A sensitivity analysis is performed with different climate change scenarios and assumptions on migration.

**Results and discussion**

Results show that the corridors play an important role in facilitating ecosystem adaptation. Some corridors are highly valuable, especially where they connect vulnerable protected areas along the gradients of future climate changes, especially altitudinal gradients.

**Conclusion**

Conservation plans enhancing landscape connectivity can increase ecosystem resilience to climate change. The role of corridors in facilitating ecosystem adaptation depends on their spatial configuration and the changes in the spatial climatic patterns. However, uncertainties in the future climate require the consideration of several climate scenarios for planning conservation under climate change.

**Keywords:** climate change, adaptation, landscape connectivity, corridor, migration

**Lui Gabriel**, Molina Silvia

**Landscape transformation in the Brazilian Amazon: threats to biodiversity and opportunities to management**

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Poster session P04, Managing biodiversity with a social-ecological system focus

**Background and goal of study**

Governmental policies and the economical variables that have been operating in Brazil from the 1960s represented a rupture in the historical process of human occupation in the Amazon, which accelerated the degradation of nature. Through correlation among ecological, historical and social perspectives, this work has proposed to characterize the last decades of human occupation in the Brazilian Amazon, understanding how the landscape transformation has generated threats to biodiversity and to forest maintenance.

**Materials and methods**

Indicators of landscape transformation in the Amazon over the past 40 years were obtained through a literature review in historical documents, articles, government reports and the analysis of satellite images. The data were organized searching the correlations among the impact of socio-economic variables, the degradation of forests and the impact on biodiversity.

**Results and discussion**

From the 1960s, the process of human occupation in the Brazilian Amazon have been characterized by factors such as population growth; opening of roads; ownership of the territory; forest removal and landscape fragmentation at regional scales; introduction of species that do not allow the recovery of the forest; removal of forest resources for commercial exploitation. As a result, while the full impact of human activities until 1970 had accumulated about 120,000 km<sup>2</sup> of forest removal, between 1970 and 2008 were deforested more than 600,000 km<sup>2</sup>. In terms of biodiversity, it is estimated that at least 20% has already been lost.

**Conclusion**

Despite the magnitude of forests destruction over the last 40 years, approximately 85% of the Brazilian Amazon landscapes are still in good repair. This gives the scientific community a unique opportunity to develop and implement new management techniques that consider the environmental characteristics of the region, combining economic development with conservation of the world's largest forest.

**Keywords:** Amazon, Landscape, Transformation, Biodiversity, Ecology

**Luis Cristina**, Carina Cunha, Cristina Palma Conceição, J. Rey-Rocha, Maria José Caramujo, Deodália Dias, Maria da Luz Mathias, Henrique M. Pereira, António Firmino da Costa

**A proposal for exploring the involvement of scientists in new ways of action in biodiversity conservation**

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Poster session P02, Biodiversity science and policy

**Background and goals**

A recommendation constantly made to scientists is that they should explore another dimension in biodiversity conservation, which is the contact with the public. So, what is needed for the scientists to become more active agents in contributing to a change of attitudes in society in order to halt biodiversity loss?

This proposal presents a strategy to: 1) Evaluate the experiences of biologists in the production of different biodiversity dissemination materials; 2) Evaluate the public's response to the biodiversity dissemination material produced.

### Materials and methods

The establishment of collaborative efforts between biology and social sciences researchers will be devised and the production of three types of biodiversity dissemination materials will be proposed. Several strategies will be proposed to evaluate the difficulties and major challenges faced by the biologists in the process of creation. Several methodologies will be proposed to analyse the public's perceptions of the contents produced by the scientists, and their response to different communication strategies.

### Results and discussion

This approach expects to: obtain guidelines for scientists on how to be more effective in producing contents and be more successful in communicating biodiversity to the public; propose strategies that will contribute to a higher involvement of scientists and to an increased public's awareness and participation in biodiversity issues; obtain results in a less explored area of research in biodiversity conservation. A through discussion will be made to this proposal hoping to bring new insights for biodiversity conservation research.

### Conclusion

This approach will help to understand how the scientists' actions in this area may contribute to biodiversity conservation. This proposal also expects to highlight new ways of better integrating biodiversity into communication campaigns in order to achieve the goal of halting the biodiversity loss at local and global level.

**Keywords:** Public Understanding of Biodiversity, Science in Society, Public Awareness, Science Communication, Biodiversity Conservation

Ma Keping, **Ji Liqiang**

**CForBio: Forest biodiversity monitoring in China**

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Poster session P17, Monitoring biodiversity

### Background and goal

The Chinese Forest Biodiversity Monitoring Network (CForBio), following the standard protocol, can simultaneously answer such an important question: How do forest structure and biodiversity change with latitude gradients? We have set up 4 forest dynamic plots (FDP) more than 20 hectare and 5 5-hectare plots, representing different zonal forests across climatic zones in China.

### Materials and methods

These plots are Changbaishan 25-ha FDP and 1 5-ha plot standing for temperate coniferous and broadleaved mixed forests, Donglingshan 5-ha FDP for warm temperate broadleaved forests, Gutianshan 24-ha FDP, Dinghushan 20-ha FDP and 3 5-ha FDP for subtropical evergreen broadleaved forests, Xishuangbanna 20-ha FDP for seasonal tropical rain forests. These plots, together with 3 planned plots of 20 hectares for warm temperate broadleaved deciduous forest and Karst tropical rain forest, constitute a network covering most of the dominant forest ecosystems in the mainland of China.

### Results and discussion

Most of species exhibit aggregated distributions matching with strong habitat heterogeneity in these plots except for the CBS plot located in a gentle slope with 17.7 m of maximal elevation difference (268.6 m in GTS plot, 240 m in DHS plot, and 160 m in XSBN plot). Obvious latitude gradients in forest biodiversity were also found in these plots. 52 species belonging to 18 families and 32 genera are found in 38,902 stems dbh (diameter at breast height)  $\geq$  1 cm of CBS plot, 159 species belonging to 49 families and 103 genera in 140,700 stems of GTS plot, 210 species belonging to 56 families and 119 genera in 71,617 stems of DHS plot, and 468 species belonging to 70 families and 213 genera in 95,498 stems of XSBN plot. Interestingly, rare species ( $\leq$  1 stem per ha) account for more than 1/3 of the species richness in these plots, 34.6% in CBS plot, 37.1% in GTS, 52.38% in DHS plot and 49.14% in XSBN plot.

**Keywords:** Forest, distribution pattern, biodiversity, species coexistence, China

Maderbacher Michaela, **Sturmbauer Christian**

**Morphological differentiation of ecologically equivalent populations and sister species in *Tropheus* – a genus of six species of cichlid fish endemic to Lake Tanganyika, East Africa**

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Poster session P06, Biological diversification

**Background and goal of study**

Lake Tanganyika harbours the oldest and most diverse species flock of cichlid fishes. Many species are subdivided into numerous genetically and phenotypically distinct populations, often classified as distinct geographical races. Other entities live in sympatry and prove their species status. With about 120 distinctly coloured populations, *Tropheus moorii* is perhaps the best model species for the study of allopatric speciation within a highly mature species flock. This study quantifies morphological differences among allopatric populations of *Tropheus moorii* and among sets of sympatric pairs of sister species. So far it has been assumed that stabilizing selection constrained overall morphology, but no stringent test was carried out

**Materials and methods**

By combining geometric morphometrics, traditional morphological measurements and population genetics we test if the observed morphological differences bear the signature of natural selection.

**Results and discussion**

Allopatric populations of *Tropheus moorii* show small but distinct morphological differences, mostly concentrated on the head. As these fish occupy the same niche in their local species community, the observed differences might either reflect a neutral drift or response to specific habitat characteristics. Morphological differences among sympatric species pairs concern also other body regions and are consistent with niche shifts due to character displacement.

**Keywords:** geometric morphometrics, allopatric speciation, adaptive radiation, natural selection, stabilizing selection

**Magodiello Mittah Malebo**, Siebert Stefan J.

**The socio-economic impact of Pilanesberg National Park on the Bakgatla community**

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Poster session P08, Conservation planning

**Introduction**

When the parks are created mention is made on wildlife conservation which includes the fauna and the flora. It is also important to note that where the national parks are established is a habitat for both human beings and animals. What becomes a challenge is the issue of addressing the livelihood of humankind within these areas when they are turned into protected areas.

**Aim**

The purpose of this study is to determine the socio-economic impact of Pilanesberg National Park to the Bakgatla community with specific reference to the Bakgatla who were relocated from the area where the Park is established. The study is exploratory, and descriptive in nature.

**Materials and Methods**

In preparation for the formal research and data collection, a questionnaire and interview questions for the focus group were developed for the purpose of collecting data. Only the Bakgatla community members who were relocated from the area where the Park is established were part of the research. Among them there were community leaders, tribal authority leaders and some senior citizen who were interviewed as part of the focus group.

**Results**

Documented data sources were also used for the purpose of gathering information. The result of this study indicates that the Bakgatla community members who were relocated including their children were and are not employed in the Park. It further shows that the socio-economic impact of the Park to the surrounding community is negative because the Park did not add value to the livelihood of the Bakgatla community. The people in the surrounding areas of the Park still live in poverty

**Conclusion**

It is evident that there is no mutually-beneficial relationship between the Park and the Bakgatla community. If the management of the Park could not address the gap that exists between the Park and the Bakgatla, it will even be more difficult to look at the other communities surrounding the Park.

**Keywords:** Socio-Economic, Impact, Pilanesberg National Park, Bakgatla, Community

**Manrique Reol Esteban, Ochoa Hueso Raúl C., Paradela-Guerrero Cristina****Nitrogen deposition effects on three early Spring therophytes species from a semi-arid Mediterranean ecosystem of Central Spain**

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Poster session P05, Drivers of biodiversity

Nitrogen (N) pollution is known to be of major concern for global biodiversity loss. Despite this, little is known about its effects on Mediterranean ecosystems. Since October 2007, we have been fertilizing experimental plots in a kermes oak (*Quercus coccifera* L.) scrubland from Central Spain in order to simulate 4 different N deposition scenarios (0, 10, 20 and 50 Kg N. ha<sup>-1</sup> yr<sup>-1</sup> over background deposition) that fall in reasonable, or a bit higher, predictions for year 2050. Moreover, in the late fall of 2008, we seeded half plots of each treatment with seeds of *Diploaxis muralis* (L.) DC., a nitrophilous species that potentially could out-compete autochthonous and poor-N environments adapted ones.

In March 2009, *Limonium echioides* (L.) Mill. germinated more in control plots than in the others ( $p < 0.05$ ), a pattern shared with *Asterolinon linum-stellatum* (L.) Duby, which showed marginally significant differences ( $p < 0.1$ ) between control and 50 Kg N ha<sup>-1</sup> yr<sup>-1</sup> treatment. This difference was significant ( $p < 0.05$ ) comparing control against all fertilized plots. *D. muralis* showed no statistically significant differences in germination regarding the different N treatments, but it germinated more in N treated plots as a whole than in control ones.

These first results show how a relative short time after the beginning of this experiment is enough for vegetation to show clear patterns associated with the reduction of one autochthonous species, while one thought to be invasive is enhanced.

With this field experiment, the first related with N pollution in Central Spain, we expect to fill a gap of knowledge of the effects of this global change factor on Spanish Mediterranean ecosystems, which are typically limited by N, and to contribute to a better understanding of ecosystem response to N deposition on a global scale.

**Keywords:** Nitrogen pollution, Nitrogen deposition, Mediterranean ecosystems, Semiarid ecosystems, Nitrogen effects

**Maphangwa Walter, Musil Charles, Raitt Lincoln****Thermal and drought tolerances of lichens as indicators of climate warming in an arid South African ecosystem**

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Poster session P16, Biodiversity indicators

Elevated temperatures, reduced fog and dew precipitation accompanying climate warming are expected to have adverse effects on sensitive lichen species which could serve as early indicators of environmental change. Responses of several different lichen species to heat and drought stress were examined under both laboratory and natural conditions. Under laboratory conditions moistened lichen species were exposed for short 2-hour periods in a forced draft oven to increasing temperatures. Under natural conditions, hexagonal open-top chambers clad with clear acrylic placed over different lichen populations artificially elevated maximum daily temperatures (average: 3.8°C increase) and partly exclude fog and dew precipitation (average: 46% decrease). Similar chambers clad with 60% light transmitting shade cloth partly excluded fog and dew precipitation (average: 49% decrease) without altering temperatures. Compartments of equivalent open-top chamber basal dimensions clad with 5 cm diameter steel mesh comprised the controls which represented natural conditions. Photochemical responses of lichen photobionts to heat and drought stress were measured with modulated and rapid rise fluorescence meters and combined respiratory responses of photobionts and mycobionts to heat and drought stress measured with an infrared gas analyzer. Diminished photochemical quantum yields and respiration rates were observed in all lichen species with elevated temperatures with

photochemical quantum yields more sensitive to heat stress than respiration rates and lichen species from cooler coastal habitats more sensitive to elevated temperatures than those from hotter inland habitats. Progressive reductions in photochemical quantum yields were also observed in moistened lichens under completely natural conditions as temperatures increased from early morning through to midday indicating that an anticipated shift from a winter to summer rainfall pattern could also detrimentally affect lichen photosynthesis.

**Keywords:** lichens, respiration, photochemistry, climate warming, drought

### **Martinez Sylvia, Biber-Klemm Susette**

#### **How the Convention on Biological Diversity affects non-commercial academic research – Access to genetic resources and benefit sharing**

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Poster session P14, Biodiversity governance

Whenever scientists intend to use genetic resources from abroad for research purposes, they need to follow specific principles established by the Convention on Biological Diversity (CBD). In 1992, it was agreed that each state has the sovereign rights to concede physical access to genetic resources on their national territory. Benefits derived from the utilization of these resources have to be shared equitably among users (researchers) and providers of biodiversity.

The Swiss Academy of Sciences elaborated a Good Practice Manual for non-commercial research. It offers easy to understand information about the international Access and Benefit Sharing system regarding academic research. It explains the necessary steps to take when requesting access to genetic resources for research purposes and identifies benefit sharing options from an academic perspective. The manual also depicts case studies. <http://abs.scnat.ch>

**Keywords:** Genetic resources, Access & benefit sharing, CBD, Good practice, policy

### **Massa Sonia**

#### **Temperature tolerance and the response of distinct genotypes of the seagrass *Zostera noltii* to heat stress conditions in Southern Europe**

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Poster session P07, Biodiversity and ecosystem functioning

#### **Background**

Although the relationship between species diversity and some components of ecosystem stability has been extensively studied, the influence of the genetic component of biodiversity on higher levels of biological organization remains poorly understood. Genetic diversity is theoretically expected to reflect the evolutionary potential of species, but very few empirical studies exist that tested that assumption. Seagrass is the basal species of one of the most important coastal ecosystems that is declining worldwide. The resistance of *Zostera noltii* to heat stress was tested in one of the warmest parts of its range, mimicking an environmental challenge that the species may have to cope with within the next decades, according to IPCC predictions.

#### **Material and methods**

The sub-lethal temperature for *Z. noltii* in the Ria Formosa was screened experimentally using a gradient of temperature ranging from 35 to 41°C in controlled conditions (aquaculture tanks with simulated tides). In parallel, temperatures were monitored in the Ria Formosa and all data were compared to IPCC predictions for temperature increases. In order to screen for a possible adaptation of some genotypes to extreme conditions, the phenotypic variability in the response to a sub-lethal heat-shock was then assessed for different genotypes, identified with 9 microsatellite markers, from two distant stands in the Ria Formosa.

#### **Results & Discussion:**

The results in terms of survival and photosynthetic activity indicate that the sub-lethal temperature is approximately 38°C, which compared to the present day already elevated maximal temperature recorded here in *Z. noltii* beds (36°C in 2007 and 38°C in 2008) raises concerns as to the survival of this species in the Ria Formosa. Our results also show a genetic and phenotypic difference between sites that can be due to genetic adaptation or phenotypic plasticity.

**Keywords:** Global warming, Genetic diversity, Heat shock, Chlorophyll fluorescence, Seagrass

**Matimati Ignatious**, Musil Charles, February Edmund, Raitt Lincoln

**The relevance of fog and dew precipitation to succulent plant hydrology in an arid South African ecosystem**

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Poster session P07, Biodiversity and ecosystem functioning

The relevance of fog for succulent plant hydrology was investigated using isotopes, stem diameter sensors and weighing lysimeters. Stable  $\delta^{18}\text{O}$  and  $\delta^2\text{H}$  isotope ratios measured in samples of rain, fog, and dew water were compared to those assayed monthly in stem xylem water of six succulent shrubs. Negative  $\delta^{18}\text{O}$  and  $\delta^2\text{H}$  ratios were observed in the stem xylem water of all six species signifying a predominance of water derived from fog and dew precipitation. These were most conspicuous during the wet winter implying that fog and dew are even more important sources of water than rain and corroborated by significant correspondence found between fog and dew frequencies, succulent foliar water contents and quantum yields of photochemistry. These studies were supplemented by monitoring diurnal variations in stem diameter in 8 succulent shrubs. Among species displaying a persistent CAM photosynthetic mode, high nocturnal fog and dew precipitation amounts corresponded with low daily amplitudes in stem diameter which pointed to reduced nocturnal stomatal water loss. These patterns were corroborated by small daily amplitudes in stem diameter also consistently observed in such species in ambient than artificially fog and dew excluded environments. Also monitored were diurnal changes in water mass of quartz gravel substrates with different dwarf succulent species. Consistently, greater net amounts of water were intercepted daily by quartz gravel substrates containing *A. pearsonii*. This attributed to a high leaf water repellence, lower leaf temperatures and less water loss by transpiration due to less radiation absorbed by its pale silvery to grey-green leaves. Quartz gravel soils devoid of plants intercepted nearly 5-times greater amounts of precipitation contributed by fog and dew than that contributed by rain implying that diminished fog and dew frequencies associated with elevated night time temperatures accompanying global warming could exacerbate plant drought stress.

**Keywords:** dew and fog, stable isotopes, succulents, photosynthetic type, transpiration

**Matsui Kiyoshi**, Horii Asami, Tsujino Riyou, Koda Ryosuke, Imamura Akio, Takada Ken-Ichi

**Recent vegetation changes under the grazing pressure of sika deer and restoration of seedling and sapling banks in a natural mixed forest of Mts. Ohmine, central Japan**

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Poster session P05, Drivers of biodiversity

**Background**

Increasing population densities of sika deer (*Cervus nippon*) have been reported during the last few decades from all over the Japanese forests. Their impact on the vegetation has resulted in the decline of biological diversity. Here we illustrate these changes in Mts. Ohmine, one of the richest temperate forests in Japan, and evaluate the regeneration potential of that forest. Further, we demonstrate the possibility of restoration of seedling and sapling banks, by using small-scale enclosure.

**Materials and methods**

In 2005, we set up a permanent plot of 1.08 ha in a natural coniferous broad leaved mixed forest at Zenki (34°06' N, 135°55' E 900-1000 m), partly overlapping with the area studied in 1983. Eight small enclosures (4\_8 m) were placed in gaps. Inside and outside of each enclosure, we put four m<sup>2</sup> quadrats, where we monitored the recruitment, survival and growth of tree seedlings. The population density of sika deer was estimated by counting dung cluster. The floor vegetation cover was recorded by 5\_5 m subplots for dominant species. The culm density of dwarf bamboo was also measured for each subplot and compared with that observed in 1983.

**Results and discussion**

The population density of sika deer was estimated as 11.2-24.0 km<sup>2</sup>. Although the culm density of *Sasamorpha borealis* was 10.7±6.0 m<sup>2</sup> in 1983 and the forest floor was almost totally covered with dense dwarf bamboos, we found only 57 culms (> 50 cm in H) in the whole plot, with the density of 0.005±0.027 m<sup>-2</sup> in 2008. *Sasamorpha borealis* almost disappeared during 25 years. Instead, *Dennstaedtia scabra*, *Skimmia japonica* and *Pieris japonica*, all of which were unpalatable species, dominated. Average densities of recruited seedlings were not different between inside vs. outside the fence. GLM analysis with step AIC showed that survivorship and growth were both larger inside the fence for all species analyzed. We conclude the studied forest still has a regeneration potential and we may assist restoration of sapling ban.

**Keywords:** small-scale enclosure, sika deer, dwarf bamboo, unpalatable species, regeneration potential

**Mead Angela**, Carlton Jim, C. I. Griffiths, M. Rius

**Revealing the scale of marine bioinvasions: The South African example**

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Poster session P05, Drivers of biodiversity

Marine species have been continuously introduced to South Africa since the arrival of the first European explorers in the 16th century. However, few studies have attempted to list the introduced biota, which remains very poorly known in relation to regions such as North America, Europe and Australia. In this review, we greatly increase the reported diversity of introduced species, based on field surveys and the re-examination of historic reports and taxonomic monographs. A total of 86 introduced and 41 cryptogenic species are recognized. This project has more than quadrupled the number of known introductions and cryptogenics within the period of a year. The inclusion of each species is justified and whereas earlier studies listed the dates of publication for each species, a date of first collection is given which better indicates the true introduction date. A preliminary analysis of the temporal and spatial patterns of introduction, based on these records, will be presented and limitations discussed. The results of this project highlight a need to combine accurate taxonomic and systematic work, broad review of both historical and more recent records and new sampling surveys across all marine habitats in a region. This approach has revealed the presence of previously misidentified, overlooked, or new introductions. Collaborative international projects, like the one presented here, can rapidly assist in identifying the true pervasiveness of marine introductions in relatively unexplored regions. This is particularly important as marine introductions are identified as one of several anthropogenic factors that are drivers of ecological community assemblage shifts spatially and temporally, leading to altered biodiversity.

**Keywords:** Cryptogenic, Marine Introductions, Patterns analysis, South Africa, Vectors

**Messouli Mohammed**, Rochdane Saloua

**Ecosystem service supply and vulnerability to global change in Morocco: A case study in the Tensift Basin**

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Poster session P12, Biodiversity and climate change

Knowledge of the interactions among ecosystem services is necessary for making sound decisions about how society manages the services provided by nature. The goal of this paper is twofold: we first investigate the environmental vulnerability index (EVI) and then explore two specific policy-relevant interactions among ecosystem services: synergisms and tradeoffs. These investigations took place at three study sites, Imlil, Asni and Tahanaout, in the High-Atlas near Marrakech.

Based on the EVI study developed by the South Pacific Applied Geosciences Commission, the vulnerability index was determined for anthropogenic, meteorological, biological, and geological events. The calculation of the EVI is based on 50 indicators of environmental vulnerability, which have been selected by global scientific and expert review.

The results revealed that the area scored relatively low on the EVI scale. Although most indicators received a score of four or less, selected indicators received scores of six and seven, which indicated a high vulnerability for these indicators. It was found that the indicators with the highest scores were mostly indicators of risk, and anthropogenic in origin.

In the following step we develop different approaches for understanding the nature of trade-offs. We consider the interactions among ecosystem services in four major sections. First, we explore the links between EVI scores, ecosystem service trade-offs and synergisms. Second, we combine the results from the scenarios and the case studies to propose some characteristics that are common to all trade-off decisions. Third, we illustrate some of the common dilemmas faced when taking ecosystem service management decisions, and discuss some of the problems of using modelling results when examining ecosystem service trade-offs. Finally, we provide a framework for anticipating win-win, lose-lose, and win-lose outcomes as a result of how people manage their ecosystem services in the study area.

**Keywords:** vulnerability index, trade-offs, synergism, climate change, north Africa

**Mey Wolfram**, Deckert Jürgen, Koch Frank**Identification books for selected insect groups**

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Poster session P19, Systematics and taxonomy

**Background and goal of study**

The taxonomic basis of most insect groups in Southern Africa is poor or inadequate. Efforts have to be undertaken to improve the taxonomic basis of important taxa. This can be done best in producing identification books. Designed as field guides they may become suitable tools and a prerequisite for taking insects into consideration in biodiversity research, and developing practical applications like monitoring, conservation measures, etc. in Namibia, RSA and elsewhere in Africa.

**Material and methods**

The Field Guides are based on the fauna of the arid and subarid biomes of South-West Africa, comprising the escarpment region from Cape Town in the South to Angola in the North. Thus, the books represent regional Field Guides. All occurring genera and the abundant species of Micro-Lepidoptera and Heteroptera are keyed and illustrated. In Symphyta all species are presented.

**Results and discussions**

The following taxa are concerned:

Micro-Lepidoptera, Macro-Lepidoptera, Heteroptera and Hymenoptera: Symphyta.

A draft of the cover design, a text page and a colour table of the books are presented as examples.

**Keywords:** Insects, taxonomy, field guide, Namibia, RSA

**Mey Wolfram****The caddisfly fauna of the Rondegat River in the Cederberg Mts., South Africa (Insecta, Trichoptera)**

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Poster session P19, Systematics and taxonomy

**Background and goal of study**

The Southern tip of Africa is a peculiar region. It is an area of Mediterranean climate and hosts a unique flora, the Cape Floral Kingdom. The complex geology of the area is dominated by old, nutrient-poor rocks and soils that affect the chemistry of mountain streams in many ways. A regular observation is the relative poverty of freshwater insects including the Trichoptera fauna. Many species are endemics or belong to endemic taxa that do not occur elsewhere in Africa. They may have evolved under the special environmental conditions of Southern Africa and are adapted to the peculiar conditions of the running waters.

**Material and methods**

Since 1997 and during the BIOTA project the author used to drive at irregular intervals from Cape Town to Windhoek and back. The Cederberg Mts. in the Western Cape are situated close to the road, and a farm in the valley of the Rondegat River was often used as a stop-over site. During each stop there, Trichoptera were sampled at various sites along the river.

**Results and discussion**

The composition of the taxocenosis, the dominant species and their changes in the course of the year and at different sample sites are documented. The survey has revealed the occurrence of distinct assemblages along the river course and a remarkable seasonality of the adults. Eleven new species were discovered. It is a clear indication that the biodiversity of the rivers of the Cederberg is not well known and still requires further study.

**Conclusions**

Patterns of limited distribution and endemism are already known from other groups in the Western Cape. The new species in conjunction with their closest relatives provide new evidence for the Cederberg Mts. as a regional centre of endemism.

**Keywords:** Insecta, Trichoptera, freshwater, taxonomy, ecology

**Mey Wolfram****The Brandberg in Namibia as centre of endemism and refuge of Lepidoptera (Insecta) – Results and lessons from an ALL-TAXA-INVENTORY**

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Poster session P06, Biological diversification

**Background and goal of study**

In Namibia, the Brandberg is regarded as a national priority for biodiversity conservation. An inventory project was implemented in 1998. The Lepidoptera fauna was then nearly completely unknown. The study was to document the fauna and to provide arguments for conservation measures.

**Material and methods**

In the course of three expeditions, a rich Lepidoptera material was collected. The whole spectrum was sampled including Microlepidoptera. The material was mainly taken at light or obtained by Malaise traps. After preparing and sorting into families, the specimens were studied by the author or sent to specialists for identification.

**Results and discussion**

The results obtained so far were published in two separate volumes of "Esperiana Memoir". Though the detection of a range of unknown species was anticipated, the high number of resulting new species descriptions came as a big surprise. A total of 124 new species have been discovered and described. Nine new genera were established. In nearly all examined families unknown species were encountered. The proportion of un-described species is about 20%. The number of unidentified species (at the genus level) is 154, which is a proportion of 25%. It can be expected that many species of this group will be described as new taxa in the future raising the proportion of novelties to well over 30%. In an initial approach towards elucidating the role and position of the Brandberg from a biogeographical point of view, disjunct distribution patterns at the species level were used. They came to light with the detection of new Lepidoptera species. Seven disjunction types were recognised, ranging from disjunctions confined to Namibia and South Africa to intercontinental disjunct patterns with the Palearctic and Oriental Regions. The genesis of these disjunctions is briefly discussed and several examples of species from different Lepidoptera families are provided for each type.

**Keywords:** Insecta, Lepidoptera, Namibia, Brandberg, taxonomy

**Mfundisi Kelebogile, Sethebe Bongani, Khaneguba Wilfred, Mosepele Ketlhatlogile****Inventorying riparian vegetation species for monitoring the Boro River, Okavango Delta**

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Poster session P17, Monitoring biodiversity

The Boro River is one of the major channels in the Okavango Delta that experiences a lot of interaction from the society in Maun. In the beginning of the 1990s, it was targeted for dredging to increase outflow into the Thamalakane River in order to augment the water supply for Maun village. However, the process of dredging was met with opposition from the local and international communities. This would have had major impacts on the biodiversity along the river, especially the riparian vegetation. The riparian vegetation provides a lot of services to wildlife and to the society in Maun. However, there is no inventory and monitoring of this vegetation. The objective of this study was to inventory plants on the riparian vegetation along the Boro River in order to provide baseline data for the monitoring of biodiversity change in the area. Sites were selected randomly, then transects were placed across the riparian vegetation and quadrats randomly selected to inventory woody and herbaceous plants. A 30m x 30m quadrat was used for sampling woody species and a 50cm x 50cm for herbaceous species. A total of 18 woody species, 9 grasses, and 29 herbs were identified in the study area. The woody species provided a habitat for understory species, which were mainly herbs. Grasses were less dominant in the understory as compared to herbs or weeds. This might be because grasses prefer to grow in open areas where there is more sunlight as compared to weeds that prefer to grow under shades. This study provided a synopsis of the vegetation dynamics within the riparian areas in the Okavango Delta. Further studies are needed for in-depth knowledge of the dynamics in riparian vegetation along major channels in the Okavango Delta.

**Keywords:** Riparian vegetation, Biodiversity, Ecoservices, Okavango Delta, Plants inventory

**Modigh Monica**, Franzè Gayantonia

**Shifts and persistence in tintinnid assemblages in the Tyrrhenian Sea: 19th to 21 century records**

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Poster session P10, Projecting 21st century biodiversity change

**Background and goal of study**

Tintinnids, or loricate ciliates, are a component of the microzooplankton and are ubiquitous in marine systems. Unlike other groups of the microzooplankton, there is a considerable amount of data of tintinnids due to the relatively easy identification of species that is based on distinctive features of the lorica. In particular, records of tintinnid assemblages for the Mediterranean Sea are available since the 19th century. Several species of tintinnids were described for the first time off Naples (Tyrrhenian Sea, Western Mediterranean) also thanks to the presence of the marine research station Anton Dohrn founded in 1872 in Naples, Italy. The aim of our study was to compare our information on tintinnid assemblages with the historical records in the Tyrrhenian Sea to verify to which extent these protozoans have resisted the environmental changes that have occurred since the first records collected approximately 150 years ago.

**Material**

Microzooplankton net samples, and in particular tintinnid species composition, have been analyzed in the last decades in the Gulf of Naples and in the Tyrrhenian Sea.

**Results and discussion**

Here we present a confrontation between our extensive data base, approximately 130 tintinnid species and several hundreds of samples examined, and the historical records from the area reported in the late '800 and early '900 as well as more recent records. On the one hand we found that a shift has occurred in the dominant tintinnid species but on the other hand some particular varieties reported more than a century ago for this area are still found.

**Conclusion**

Tintinnids feed on pico and nanoplankton and are thus directly connected with the microbial food web that forms the basis of the oceanic ecosystem. Studies of tintinnid assemblages may highlight alterations in planktonic food webs and provide information on long term changes in the marine environment.

**Keywords:** tintinnids, Mediterranean, Tyrrhenian Sea, diversity, environmental change

**Mohamed Ben Salah**

**Agro-biodiversity and traditional knowledge in the coastal Tunisian oases**

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Poster session P03, Agrobiodiversity

The Tunisian coastal oases constitute a unique model of very rich plant biodiversity where more than 40 species in different cultivated floors cohabit. The date palm constitutes the highest floor. The second is occupied by fruit trees. The lowest groups various species: vegetables, fodder, industrial, ornamental, condiments and tinctures plants. The present paper constitutes the result of a MARP diagnosis which had the objective to raise the plant diversity, and traditions and uses of the products in those oases. The diagnosis showed a rich date palm diversity and knowledge of the population. It revealed the existence, among others, of nearly 35 local varieties of date palm and of nearly 40 other cultivated plant species. Under a high palm tree grow olive and fig trees, pomegranate and vine grapes. Underneath grow cereals (wheat, Barley, corn, but, sorghum) vegetables (onion, carrots, tomatoes, melons ...), pastures and many other plants: rose trees, jasmines, thyme, rosemary, sage, lavender. Some aromatic plants: Cumin, caraway, coriander are cultivated. And we can see also co-planted pepper, fenugreek, rubia and Lawsonia). This survey nearly shows 20 uses of dates and by-products of the date palm under different shapes: fresh consumed, kept, or transformed. It showed also that the habitants of these oases possess, for a long time, a knowledge to make ingenious concerning use and conservation of the products and by-products of the date palm and make some uses: culinary, medicinal and utilitarian (construction of their houses, fences, bridges and borders).

This survey has all as much showed the factors that risk weakening this balance for a long time maintained in these oases. Urbanisation, lack of water, and losses of good agricultural practices are some of those factors. Some recommendations are also presented in this paper for system maintainance and conservation.

**Keywords:** Biodiversity, Agriculture, oases, knowledge, Tunisia

**Mohd Yusof Abdul Malek****Land use dynamic at the inside and outside of a wildlife protected area in a highly developing region of peninsular Malaysia**

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Poster session P13, Analysing patterns and trends

**Background and goal of the study**

Assessing the land use dynamic of protected areas is an urgent need to identify the main priorities for conservation planning and management. This is particularly important in highly developing countries or regions, such as peninsular Malaysia. Thus far, assessing the dynamic of land use is mostly focused on the inside of the protected area, while the land use of its surrounding area has received less attention though it plays an important role to influence changes at the inside. Therefore, the objective of this study was to assess the land use dynamic at the inside corresponding to the outside of protected areas in the State of Selangor, the most highly developing region in peninsular Malaysia.

**Materials and methods**

Two protected areas were chosen as a case study, that is, Templer and Klang Gate Wildlife Reserves. Three TM Landsat satellite images of 1988, 1996, and 2005 of the protected areas were processed and analyzed, using a GIS application in order to develop land use maps for each year. In this study the outside was defined as the 5 km zone surrounding the protected areas.

**Results and discussion**

Analysis revealed that over the three periods, forested areas decreased steadily whereas agricultural and built-up areas increased at both sites of the protected areas. However, the tremendous changes occurred between 1988 and 1996 compared to those between 1996 and 2005. The agricultural area was dominated by rubber and oil palm plantations but between 1996 and 2005, they were mostly converted into a built-up area. Nevertheless, the increase of a built-up area between 1996 and 2005 was less than that between 1988 and 1996.

**Conclusion**

In conclusion, the dynamic of land use at the inside of the protected areas corresponded to that of the outside. Thus, further development at the surrounding area could have the potential to provide an implication on the sustainability of the reserves as a conservation area of biodiversity.

**Keywords:** protected area, land use, agriculture, urbanization, conservation

**Monteiro Sonia, Emmerson Mark****Biodiversity Research In Ireland – The importance of establishing a DIVERSITAS National Committee**

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Poster session P20, National DIVERSITAS Committees and National Programmes

Ireland has undergone unprecedented economic growth in the last 20 years. How this development is likely to impact on Ireland's native biodiversity remains unclear. Ireland has a relatively mild climate and it is geologically diverse whilst being relatively species poor. Its coastline and territorial waters do support a wealth of marine diversity while its unique topography has contributed to the development of varied and unique habitats such as bogs, turloughs and the Burren. Degradation and loss of habitat are currently considered the main factors affecting biodiversity in Ireland.

Ireland has a National Biodiversity Plan whose main purpose is to ensure the conservation and sustainable use of biological diversity in Ireland and to contribute to conservation and the sustainable use of biodiversity globally. The National Platform for Biodiversity is sponsored by the National Parks and Wildlife Service and the Environmental Protection Agency to assist biodiversity research by connecting the research community, stakeholders, policy makers, and the public. In 2006, they published a Biodiversity Knowledge Programme for Ireland (2006), outlining a strategic framework for national biodiversity research.

Now more than ever, especially in light of the current economic climate, an integrated approach to biodiversity research is of the utmost importance. We show how the developments in biodiversity research in Ireland are contributing to the development of a National DIVERSITAS Committee that will help to facilitate and integrate the different aspects of biodiversity research nationally and will give strength to a field which can still develop further, promote cooperation between researchers and other stakeholders, facilitate access to international programmes and funding and help to put Ireland at the cutting edge of biodiversity related research.

**Keywords:** Ireland, Biodiversity, Research, DIVERSITAS, conservation

**Muhar Andreas**, Daniel Terry D., Taczanowska Karolina

**Cultural ecosystem services: Less tangible, less important?**

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Poster session P18, Managing for ecosystem services

Humans usually do not perceive biodiversity per se, they are rather affected by environmental interactions at landscape scale, where bio-physical patterns of ecosystems are most directly perceived, appreciated and acted upon. At this scale, aesthetic and recreational experiences, interactions with wildlife, identification with cultural heritage, sense of place, and spiritual actualization arise rather directly and play a central role in determining what ecosystems and components people are disposed to appreciate and to protect.

The Ecosystem Services (ES) concept acknowledges these cultural services of ecosystems, and they have historically played a central role in promoting positive public attitudes toward nature conservation and environmental protection. In wealthy societies, deficiencies in supporting, regulating, and provisioning ecosystem services can to a certain extent be compensated by technical measures; cultural services are more difficult to substitute: Sites of cultural significance usually have a long tradition of use, therefore e.g. traditional spiritual sites can hardly be "displaced" or "replaced", in particular not within a short time period.

Despite their general recognition in the ES concept, cultural services are often only superficially integrated in research projects. This might be due to the fact that they are less tangible than other services. Methods developed in the field of environmental economics for quantifying cultural services have been widely criticized for being too economic, not reflecting the complexity of the cultural aspects of the human-nature relationship.

We will present (1) results from a literature survey on the consideration of cultural services within the ES concept, (2) ideas for the development of a bridge concept to better integrate cultural services, (3) a preliminary compilation of research needs, and (4) a proposal for the organisational integration of cultural services in research processes and programs.

**Keywords:** ecosystem services, cultural services, landscape aesthetics, sense of place, valuation

**Muhar Susanne**, Preis Sabine, Zitek Andreas, Schmutz Stefan

**The EU Water Framework Directive and Natura 2000: A Framework for the conservation and development of biodiversity in rivers and floodplains**

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Poster session P08, Conservation planning

Near-natural freshwater ecosystems and their floodplain zones are hotspots of biodiversity, and therefore priority areas for measures towards biodiversity conservation. Restoration efforts also assist to increase biodiversity and initiate the re-establishment of those ecosystem functions and services, which had been degraded by intensive human use. The EU Water Framework Directive, complemented by the Birds and the Habitats Directive, has the potential of being a major driver for the integrative management of river-floodplain systems. First pilot examples of such management approaches included attempts to harmonise the differing requirements of those directives. Three large Alpine rivers were subject to EU-Life Nature Projects, where comprehensive restoration programmes have been implemented. The measures vary in type and scale and address the impacts of different human uses by re-initiating type-specific processes (e.g. floods, erosion, sedimentation) and restoring type-specific habitat conditions. In a monitoring programme the pre and post restoration conditions were investigated at different spatial scales, and evaluated with regard to reference conditions. The state of the river stretches prior to and after restoration was assessed by field mapping of hydro-morphological criteria as well as surveys of the fish fauna. Direct (e.g. habitat and fish species, composition) as well as indirect indicators (e.g. river type index, longitudinal and lateral connectivity, area of characteristic habitat types, land use) were applied to evaluate the ecological status. Results indicate that only the large-scale measures had a significantly positive effect on habitat and species diversity. In a final step, these results were linked to the framework of aquatic ecosystem functions and services at a local and regional scale, and a perspective for future activities, a hierarchical concept for catchment orientated conservation, and restoration measures have been developed.

**Keywords:** freshwater ecosystem, biodiversity, ecosystem services, restoration, conservation

**Munsie mupidi Patrick,****Plant biodiversity and malnutrition**

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Poster session P04, Managing biodiversity with a social-ecological system focus

Given the difficulty of precisely identifying optimal diets, diversity provides an intrinsic buffer against uncertainties posed by lack of knowledge and by environmental change. Plant biodiversity offers useful perspectives on a number of issues of contemporary scientific and public health importance including, micronutrient deficiency and bioavailability, nutrition and disease, the nutrition transition, and medicinal and functional activities of plants. Globally, simplification of the diets of large numbers of people to a limited number of high-energy foods as a result of urbanization and socioeconomic changes presents unprecedented obstacles to human health associated with emerging diseases such as diabetes, hypertension and cancer. Greater use of plant biodiversity based on scientific evaluation of plant properties, cultural support programs, dietary education, innovative processing and marketing provides a possible avenue for mediating the impacts of change. The diverse nutrition and health functions that plants serve in traditional culture, and indigenous knowledge of plant diversity, offer potentially valuable solutions that enable biodiversity to address the problems facing contemporary society. This paper summarizes empirical evidence supporting the hypothesis that dietary diversity is essential for health and that biodiversity can be equated with dietary diversity. Further population studies on the relationship of dietary diversity including in plant varieties and health as well as research into mechanism through which diversity affects individual health are needed to test the validity of this hypothesis. Nutritional blindness is presented as a case where attention on one nutrient, vitamin A, overshadows important diseases such as cataracts and the potential importance of plant resources in mediating their effects.

**Keywords:** functional food, biodiversity, dietary diversity, indigenous knowledge, nutritional blindness

**Mutumi Gregory, Cumming Graeme****Using stable isotope analysis to trace the movements of ducks in Southern Africa**

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Poster session p17, Monitoring biodiversity

**Background**

The conservation and management of mobile species relies on an adequate understanding of their movement patterns. Quantifying movements is non-trivial for species that can respond rapidly to environmental fluctuations over large areas. Relatively little is known about the movement patterns of Southern African waterfowl, which are important links between wetlands as well as game and food species and potential vectors of avian influenza. We tested the potential of stable isotope analysis of wing and body feathers to provide useful information about the movements of nomadic African ducks and their feeding habits during flightless moult. Ducks offer an interesting test case because they regrow their wing feathers synchronously in a single location following moult.

**Materials and methods**

Feather samples (a secondary feather and a body feather) were collected from the ducks from 5 sites located in different biomes during the period 2007 to 2009. Samples were analysed for  $\delta N$ ,  $\delta O$ ,  $\delta H$  and  $\delta C$ . Isotope ratios were analysed to determine the variation within and between individual locations, species, populations, and times of year.

**Results and discussion**

Initial analysis of 80 feather samples from 2 species (Egyptian goose and Red-billed teal) from two sites (Barberspan and Strandfontein, in South Africa) and different seasons indicated that isotope ratios were distinct by site and by time of year, suggesting that we may be able to match ducks to their moulting origin using isotopic analysis of feather samples, or at least to determine the variety of moulting locations used by a single population of birds captured from one site. Interestingly, although EG are grazers and RBT are dabblers, the two species did not have unique isotopic signatures in their wing feathers, suggesting the potential for dietary convergence (and hence, competition) during moult. Further analysis is currently in progress and we will report results from a larger sample size in October.

**Keywords:** isotope, avian, Southern Africa, management, nomadic

**Nanema K. Romaric****Identification and characterisation of descriptors for *Solenostemon rotundifolius* (Poir J. K. Morton) (Lamiaceae)**

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Poster session P03, Agrobiodiversity

**Background and Goal of Study**

*Solenostemon rotundifolius* or country potato is cultivated in Tropical Africa for its edible tubers. It is a multipurpose crop that is well adapted to African farming conditions. It has been one of the staple crops in sub-saharan Africa, but currently, it is neglected and its genetic resources are on the way of disappearing. The aim of this study was to identify and to characterise some descriptors for *S. rotundifolius*.

**Materials and Methods**

155 accessions were collected in 20 provinces of Burkina Faso from December 2004 to June 2007. A morphoagronomic characterisation was carried out from July to December 2007. The experimental design was Fisher Randomised Blocks. An experimental field of 3,072.8 m<sup>2</sup> (66.8 m x 46 m) was subdivided into three blocks two metres apart.

**Results and Discussion**

A total of 50 morphological traits (16 qualitative and 34 quantitative) related to the foliage, the tubers and the cycle of development were identified and evaluated. The analysis of the relation between the quantitative traits revealed some interesting correlations between the foliage, the cycle of development and the tubers production.

**Conclusion**

The identified morphological traits could be used as descriptors for *S. rotundifolius* germplasm description and for future breeding programmes.

**Keywords:** Country potato, tubers, cultivars, descriptors, Burkina Faso

**Napolitano Constanza, Poulin Elie****Effects of landscape perturbation on population parameters of kodkods (*Leopardus guigna*, Mammalia, Felidae) on Chiloe Island, southern Chile**

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Poster session P05, Drivers of biodiversity

**Background and Goal**

Landscape perturbation is the main cause of species extinction worldwide. Wild felids are one of the most threatened groups inhabiting a perturbed landscape, mainly because of their large home ranges, low population densities and highly territorial behaviour. The kodkod (*Leopardus guigna*) is the smallest felid in Chile and is described as highly associated with the temperate rain forests. It is considered as Endangered due to habitat loss and fragmentation and also illegal killings. My goal was to estimate for the first time the direction and magnitude of the effects of landscape fragmentation on demographic and genetic population parameters of kodkod populations in Chiloe Island, and to evaluate how they could threaten the persistence of the species in the long term.

**Materials and Methods**

I collected faeces non-invasively and blood samples through live-trapping of individuals in study sites with different levels of landscape perturbation. I carried out DNA extraction and amplification using different molecular markers, mitochondrial, microsatellites and sex. I used these multilocus genotyping data to determine demographic and genetic kodkod population parameters and finally compare them between the different study sites.

**Results and Discussion**

Genetic diversity is lower in more perturbed landscapes. Close relatives remain geographically closer in perturbed landscapes, suggesting low dispersion. High kinship levels decrease with distance in perturbed landscapes, suggesting dispersion limits. Some geographic features act as barriers while others allow dispersion of individuals.

**Conclusions**

Landscape perturbation has negative effects over kodkod population parameters. The results of this study will increase awareness of the importance of preserving native forest habitat and improve protection of kodkod populations, facilitating conservation actions for this largely unknown small felid and its unique ecosystem.

**Keywords:** perturbation, kodkods, landscape, molecular markers, genetic diversity

**Ndlovu Mduduzi, Cumming Graeme, Hockey Phil****Phenotypic flexibility in an African waterfowl**

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Poster session P06, Biological diversification

**Background**

The long-term persistence of populations under climate change will depend on their ability to respond favourably to changing environments. All ducks undergo an annual flightless moult when the primary feathers are dropped and regrown. This moulting period is a vulnerable stage that will be strongly influenced by environmental change. To better understand the potential for fine-scale adaptation, we investigated the degree to which the body condition, organ mass (pectoral muscle, gizzard, liver and heart) and flight feather growth of Egyptian Geese (actually a kind of duck) living in variable environments showed phenotypic flexibility over the c. 37 days of flightless moult.

**Methods**

Body mass, condition, and flight feather growth were measured in 500 Egyptian Geese caught during moult in 2007 and 2008 at Barberspan and Strandfontein in South Africa. A body condition index was obtained by dividing mass by the product of two reliable structural measurements, head and tarsal length. Mean daily change in primary feather length was calculated for individuals recaptured within five days of initial capture. 20 birds were dissected for internal organ study.

**Results and Discussion**

Mean body mass and condition declined at the start of moult and continued to do so until flight feathers were at least two-thirds grown. Non-moulting Geese had high pectoral muscle mass (26% of body mass) which decreased with the onset of moult but started to increase before overall body mass increased. Gizzard mass showed the opposite trend; liver mass increased throughout moult; and heart mass stayed constant. Feathers grew fastest at intermediate lengths. The results suggest that Egyptian Geese minimise the duration of flightlessness while maximising their potential for nutrient intake during moult. Their high degree of phenotypic flexibility suggests that they will adapt well to local change and may partly explain their recent population expansion in South Africa.

**Keywords:** moult, condition, adaptation, duck, management

**Nyaga Justine Muhoro, Musil Charles, Raitt Lincoln****Empirical and theoretical based model predictions of respiration in different soils of an arid South African ecosystem: Impact of climate warming**

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Poster session P12, Biodiversity and climate change

An empirically-based soil respiration (EMR) model was compared with a theoretically based general soil respiration model (GRESP). Data for the EMR model were obtained from morning and afternoon measurements of soil respiration rate, soil temperature, moisture, nitrogen and phosphorus contents conducted monthly in five different soil-vegetation units in natural and artificially manipulated soil environments. Artificial manipulation of soil environments comprised the partial exclusion of precipitation only from soils using square chambers whose roofs were clad with louvered clear acrylic and sides clad with 60% light transmitting shade cloth. The combined passive warming and partial exclusion of precipitation from soils was achieved with clear acrylic hexagonal open-top chambers. Standard least squares regressions quantified the relationships between soil respiration rate and measured soil physical and chemical properties in the natural and artificially manipulated environments, and their interactions for each of the 5 soil-vegetation units. Requisite functions for the GRESP model included Q10 coefficients, derived from exponential regressions of measured soil respiration rate against soil temperature at soil water contents above field capacity for each soil vegetation units, these reduced by half for dry conditions, and the maximum retentive and field capacities of soils obtained from buried soil moisture sensors. EMR model predicted soil respiration rates displayed better correspondence with

measured soil respiration rates than GRESP model predicted soil respiration rates, with the EMR model residuals more closely approximating normal distributions than the GRESP model residuals for all soil vegetation units. EMR modeled soil respiration rates under future climate warming (SRES A2-high scenario) indicated slight reductions in soil respiration rate in those soils with sparse vegetation cover and slight increases in soils with moderate vegetation cover during the wet winter season only. Results concur with recommendations that more empirical data from whole ecosystem warming experiments are required to obtain closer interactions between models and experiments.

**Keywords:** Soil respiration, Climate warming, Model predictions, ERM model, GRESP model

**Odhiambo Judith**, G.M Siboe, C.W. Lukhoba, S.F Dossaji

**Antifungal bioactivity and phytochemical relatedness among selected medicinal plants used in treatment of fungal infections in the lake Victoria basin, Kenya**

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Poster session P09, Global environmental change and health

**Background and Goal of study**

HIV/AIDS remains a global problem, and a human tragedy. Sub-Saharan Africa has just over 10% of the World's Population but is a home to more than 67.8% of people living with AIDS in the world. The Kenyan Lake Victoria basin has the highest prevalence rates of HIV/AIDS in the country. HIV/AIDS patients face health risks from opportunistic illnesses that compromise their lifestyles. At least 10% deaths of HIV/AIDS patients are caused by opportunistic infections most of which are fungal. The few antifungal agents available are expensive and have adverse side effects. Medicinal plants have been used since time immemorial to treat numerous diseases in many parts of the world and could be potential source of drugs for managing opportunistic fungal infections in HIV/AIDS patients.

**Materials and Methods**

Various herbs/herbal preparations claimed to treat fungal infections were collected and tested for their antifungal activity by disc diffusion technique. Six plants were selected for bioactivity analysis. Extractions were done using water and dichloromethane: methanol (1:1). The activity was tested on *Candida albicans* and *Aspergillus niger*.

**Results and discussion**

Dichloromethane: methanol extracts of *Toddalia asiatica*, *Rhamnus staddo*, *Momordica foetida*, *Podocarpus falcatus*, *Aloe sp.*, *Gladiolus dalenii* showed activity against one or both of the test organisms. *P. falcatus* showed the highest activity against *A. niger* while *M. foetida* showed the highest activity against *C. albicans*. *G. dalenii* extracts inhibited spore production in *A. niger*. Three out of six plants showed significantly higher antifungal activity than the commercially used drugs Ketoconazole and Griseofulvin.

**Conclusion**

The antifungal activity of the selected plants makes them potential source of antifungal agents and may be of economic importance as source of antifungal natural plant products.

**Keywords:** Ethnomedicine, Antifungal, *C. albicans*, *A. niger*, HIV-AIDS

**Ogburn Matt**, Edwards Erika

**Plastic responses to pulse-driven water variability in *Talinum paniculatum***

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Poster session P03, Agrobiodiversity

**Background and goal of study**

Plants of arid habitats face considerable variability in water supply, and this is expected to increase unpredictably in the future as a result of climate change. Previous experiments have imposed complete drought on well-watered plants, but a more realistic mode may be precipitation pulses, with varying time between and/or magnitude of pulses. Modeling experiments predict varying water pulses will favor different plant phenotypes. We tested whether a generalist arid plant species could respond plastically to pulse-based variation in water supply.

**Materials and methods**

We subjected seedlings of *Talinum paniculatum*, a widespread herb of Neotropical dry forests, to factorial watering treatments varying both frequency and total amount of water applied. We measured growth, stomatal behavior, photosynthetic rates, overnight acid accumulation, and succulence at the tissue and cellular levels.

**Results and discussion**

Plants receiving infrequent but plentiful pulses of water (Group B) showed a highly attuned photosynthetic response. Photosynthetic rate was significantly higher after watering and gradually dropped off throughout the course of a week, while well-watered control plants maintained a consistent level throughout the same period. Conversely, overnight acid accumulation in Group B plants increased steadily with increasing drought, indicating CAM-cycling, while remaining consistently low in control plants. Leaf succulence and dry weight root/shoot ratios were not significantly different between treatments, indicating low plasticity of these morphological responses.

**Conclusions**

These results indicate that *T. paniculatum* responds to variability in moisture conditions through rapid adjustments to the photosynthetic pathway, but not through long-term alterations in tissue succulence. CAM-flexible, generalist species may be in a good position to cope with climate change-induced variation in moisture through close tracking of water supply.

**Keywords:** plasticity, climate change, precipitation, aridity, photosynthesis

**Olango Temesgen Magule, Tesfaye Bizuayehu****Managing Diversity of an 'Orphan' Crop: the Case Study of Enset (*Ensete ventricosum* (Welw.) Cheesman) Landraces in Wolaita, Southern Ethiopia and Implications for On-farm Conservation**

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Poster session P03, Agrobiodiversity

**Background and Goal of Study**

Enset, an 'endemic' staple and co-staple food crop for about 13 million people of Ethiopia, is often called 'the tree against hunger'. The Wolaita are among 'the people of enset culture' in the Southern Ethiopia, growing it for food, fiber, medicine, animal feed and income generation. The farmers assemble large number of landraces in their enset garden to achieve these use values of the crop. This study hopes to contribute to enhancement of conservation efforts in the context of high potential but underutilized crops, often called 'orphan crops'. Its aim is assessing the extent and indigenous management of enset diversity in Wolaita, and there by identify factors affecting it.

**Material and Methods**

Stratified random sampling technique was employed to select 225 enset gardens from 9 Peasant Associations (PAs) of Wolaita zone in southern Ethiopia. Shannon-Weaver diversity index and Sorenson's similarity coefficient were used to assess the diversity across farms, PAs and altitudes.

**Results and Discussions**

A total of 59 named landraces were recorded. The number of landraces maintained on individual farms ranged from 2 to 33 with mean and standard deviation of 7.4 and 3.63 respectively. Most (78%) of the landraces had limited distribution and abundance, and only few dominant landraces were widely grown. Perceived as morphological and cultural traits, individual landraces were recognizable on basis of 'sex' (male and female) and use (food, medicine, and processing). Socio-economic factors (farm size, land per capita and size of live-stock) and elevation are found to be determinants of management of enset diversity. Combination of local practices: propagation, planting patterns, and mixed harvesting and processing of landraces were described for implication of farmers role in managing the dynamics of enset diversity in Wolaita. Furthermore, the enhancement and conservation significance of the crop is discussed.

**Keywords:** Enset, Ethiopia, Landrace diversity, On-farm conservation, Wolaita

**Omara-achong Theresa**, Edu Esther, Nkang Ani

**Survey of Indigenous Vegetable Species In Calabar and Ogoja, Cross River State, Nigeria**

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Poster session P03, Agrobiodiversity

Studies to determine the extent of cultivation, price trends, seasonal availability, culinary changes and consumption preference patterns of indigenous vegetable species were undertaken in Calabar and Ogoja Local Government Areas in Cross River State (between 4° 27' and 5° 32'N), Nigeria. The study area falls within the tropical rainforest ecozone. Vegetable is defined in the context of this paper as the edible parts of plants. The indigenous vegetable species identified included *Gnetum buchholzianum*, *Piper guineense*, *Heinsia crinata*, *Lasianthera Africana*, *Talinum triangulare*, *Verninia amygdalina*, *Brachysetegia eurycoma*, *Gonggrynema latifolium*, *Corchorus olitorius*, *Bombax Buon-opoense*, *Pterocarpus soyauxii*, *Ficus glumosa*, *Zheneria cordifolia*, *Celosia argentea*, *Vitex doniana*, *Uapaca heudeloti*, *Irvingia gabonensis*, *Mucuna sloanei*, *Sesamum indicum*, *Telfairia occidentalis* and *Colocynthis vulgaris*. Other than culinary uses, some of these species also have medicinal and ornamental value. Some of the species had limited geographical distribution (mostly within ethnic boundaries). *Telfairia occidentalis* and *Colocynthis vulgaris* enjoyed wide cultivation and also had high consumption preference indices (27.55 % and 30.44 %, respectively). Increasing urbanization and population pressure has led to deterioration of natural resources and consequently of biodiversity in this ecozone.

**Keywords:** Vegetable, Indigenous, Biodiversity, Calabar, Nigeria

**Oszlanyi Julius**, Kalivoda Henrik, Július Oszlányi

**Landscapes biodiversity changes in the context of socio-economic development. Example from Slovakia**

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Poster session P17, Monitoring biodiversity

The floodplain of the Morava River is a very important and significant area with regards to its biological and ecological assets. The intensive exploitation of great streams and their alluvia in Central Europe started after the Second World War. However, this trend did not concern the Slovakian part of the Morava River because it coincided with the boundary of the CSSR-Austria and as such was part of the area of the Iron Curtain in the years 1948–1990. The whole area was tightly closed and absolutely inaccessible to the public. This is how the Morava River conserved almost a natural character precisely in the section which coincides with the boundary with Austria. Thanks to the fact, a unique complex of wet meadows, swamps and forests unrivalled in Slovakia or in Central Europe has survived in a 71 kilometres long section of the boundary. The overall area of meadows amounts to more than 2000 ha. Alluvial forests coat more than 3000 ha and represent an extremely important landscape-ecological element which forms the character of the Morava River floodplain and after all that of the entire boundary area in the region of Záhorie. The River Morava floodplain has been entered in the RAMSAR List of Wetlands of International Importance on 26 May 1993 and constitutes a part of the NATURA 2000 system of protected areas. The Morava River also maintained its natural character on the Austrian side including nature reserves and wetlands registered under the Ramsar Convention. Part of the Austrian floodplain was designated the WWF protected area of March Auen (Morava floodplains) area and another part is protected as part of the National Park of Donau-Auen.

**Keywords:** landscape, biodiversity changes, socio-economic changes, former Iron Curtain, ecological land-use

**Ouarghidi Abderrahim**, Powell Bronwen, Martin Gary, Kool Aneelen, De boer Hugo,

Abbad Abdelaziz

**Do experts know? Identification of medicinal roots by herbalists in Marrakech markets**

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Poster session P09, Global environmental change and health

The use of medicinal plants is widespread throughout Morocco and the herbal markets in Marrakech are especially famous for the diversity of their products. After many years of research with herbalists in these markets it became clear that their ability to identify medicinal roots was variable. We conducted a study to determine exactly how well herbalists, who are considered experts, are able to identify 30 of the most commonly used roots from the Marrakech market. Herbalists were presented with an identification task in which they were asked the vernacular names of roots specimens. The botanical identity of the root specimens, which had been collected in collaboration with local collectors, was determined at the Institut Scientifique de Rabat using standard taxonomic methods. We found surprisingly low performance and wide variation between herbalists on the identification task. We also found a great deal of substitution of medicinal roots evidenced by multiple scientific species being sold under a single vernacular name. Our findings suggest that this substitution occurs very early in the supply chain.

**Keywords:** Identification, herbalist, collectors, medicinal roots, ethnobotany

**Ouédraogo Elisée****Soil macrofauna enhance the efficiency of soil and water conservation measures in semi-arid West Africa**

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Poster session P07, Biodiversity and ecosystem functioning

**Background**

Soil fauna play a key role in sustaining environmental services especially in semi-arid zones. A study to assess the contribution of soil macrofauna communities and diversity to the efficiency of soil and water conservation (SWC) measures was conducted in Burkina Faso in 2008. The main hypothesis is that the beneficial effects of SWC measures on soil water conditions and crop water and N use efficiency can be more fully exploited when soil macrofauna diversity/activity is stimulated at the same time.

**Materials and Methods**

The experimental design is a split plot design with three replicates. Fauna and non Fauna plots are the main treatments. Non Fauna plots are established with the use of pesticides. Different soil management technologies are used as sub-treatments and assessed as a whole and consisted of Tillage + Urea; Tillage + Compost; Tillage + Compost + Urea; Tillage + Straw + Urea; No Till + Straw (Mulching); No Till + Straw + Urea; Fallow and compost plot. Tropical Soil Biology and Fertility (TSBF) methods are used to assess soil macrofauna communities and diversity. Runoff plots have been established to measure runoff.

**Results and discussions**

The results showed that the presence of soil fauna increased the efficiency of the different SWC technologies in reducing runoff and soil erosion. The treatment Tillage + Straw + Urea and No Till + Straw + Urea were the most efficient in controlling runoff after fallow. Moreover, the highest number and diversity of soil macrofauna were found in these treatments. These results show the importance of soil macrofauna in the cropping systems and their impacts in reducing land degradation.

**Conclusions**

We conclude that the efficiency of SWC conservation measures can be optimised when soil macrofaunal activities and diversity can be stimulated at the same time.

**Keywords:** Diversity, Runoff, soil macrofauna, semi-arid, SWC measures

**Ouma Caleb****Biodiversity Conservation through Participatory community forest management in Kenya**

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Poster session P04, Managing biodiversity with a social-ecological system focus

**Background**

Local knowledge and biodiversity are inseparable. The co-evolution of cultures, life forms and habitats have played a greater role in conserving plants biodiversity. Local communities everywhere have developed knowledge and found ways to derive their livelihood from the bounties of nature's diversity. The local people have therefore, used plants products for various purposes, the use being influenced by their perception and attitudes.

**Goals and Objectives**

The study focuses on the following objectives: To assess the effectiveness of community participation on management and utilization of forest resources; To assess the impact of participatory forest management on the livelihood of different stakeholders; To determine which socio-economic and demographic factors affect the level of household's participation in community forest management and analyze the relationship between participation and benefits received from forest resources and To assess to the perception of the local households towards the participatory forest management and factors responsible for variation in attitudes. The key hypotheses to be tested include: "Active participation in forest management is affected by the perceived benefits received from such participation" and "The participatory forest resource management has a positive impact on livelihoods of the different stakeholders."

**Materials and Methods**

Observations, Oral interviews schedules, and Questionnaires will be used to collect data.

The data so collected will be analyzed using statistical techniques especially the descriptive statistics. The results, conclusions and recommendations will be drawn after the study.

**Keywords:** Biodiversity, Participatory, Conservation, Bio-cultural knowledge, Perception

**Parfenova Elena, Tchebakova Nadja**

**Potential biodiversity of main conifers in a changing climate in the Altai-sayan mountains**

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Poster session P12, Biodiversity and climate change

This study was aimed to evaluate the potential effect of climate change on the distribution of major conifers in the Altai-Sayan mountains: *Abies sibirica*, *Pinus sibirica*, *sylvestris*, *P. sylvestris*, *Picea obovata*, *Larix sukaczewii*, *L. sibirica*. We used our bioclimatic models which determine unique climatic limits for trees from three bioclimatic indices: growing degree days, base 50C, negative degree days, base 0C, and annual moisture index. A conifer distribution predicted only from climatic variables was then corrected for permafrost which controls it in the Altai-Sayan mountains. Each conifer distribution was mapped by coupling our conifer bioclimatic models with climatic indices and the permafrost in current climate and in the future (2020, 2050, and 2080) distribution applying GIS-software. Climatic anomalies for the future climates were derived from two climate change scenarios: the HadCM3 A1FI and B1 reflecting the largest and the smallest temperature increase correspondingly.

Nowadays, the largest biodiversity of conifers in the Russian part of Asia is found in lowlands of the Altai-Sayan mountains. Warming and drying future climate should become more suitable for drought-resistant, *Pinus sylvestris* and the *Larix* genera as a whole. Habitats for water-loving conifers, *P. obovata*, *Pinus sibirica* and *Abies sibirica*, would shrink and shift upward by 2080. The potential biodiversity of the Altai-Sayan ecoregion conifers seems not to change with climate change and will be associated with the mountains habitats for trees.

**Keywords:** the Altai-Sayan mountains, conifers biodiversity, bioclimatic modeling, GIS, climate change

Pauli Natasha, Oberthur Thomas, **Barrios Edmundo**, Conacher Arthur

**Fine-scale spatial and temporal variation in earthworm surface casting activity in agroforestry fields, western Honduras**

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Poster session P13, Analysing patterns and trends

**Background and Goal of Study**

Quantification of the spatial and temporal distribution patterns of soil fauna is a relatively new area of research, and has been proposed as key to understanding the high diversity of soil fauna communities. Field research on the relationships among the spatial distribution patterns of trees, litter and earthworm surface casting was carried out in two agroforestry fields in a rugged area of western Honduras.

**Materials and Methods**

Grid-based sampling at a scale of 2-20 metres was used to determine whether any spatial relationships existed among the distribution patterns of trees, litter and earthworm casts at the soil surface. Two fields were sampled at either two or three week intervals, to determine the short-term stability of any spatial relationships.

**Results and Discussion**

The spatial distribution of litter showed a strong pattern of aggregation, whereas earthworm cast distribution did not exhibit strong spatial autocorrelation. However, the spatial distribution patterns of each of these variables were well explained by the presence of trees in both fields. Fitted model cross-semivariograms explained between 70 and 90% of the total variation in cross-semivariance between tree density and litter cover, and between tree density and earthworm cast weight. Earthworm surface casting activity and litter cover were both positively associated with tree distribution. Over the short time scale of the study, unusually heavy rainfall led to substantial changes in spatial distribution patterns of earthworm casts and litter cover.

**Conclusions**

The results of the study suggest that farmers may be able to manipulate populations of earthworms indirectly by managing the density and distribution of trees within their crop fields, which may lead to significant effects for soil quality and biodiversity. Further, the results emphasise the need to take into account short-term temporal change during ecological studies at fine spatial scales.

**Keywords:** Earthworm casts, Spatial heterogeneity, Temporal variation, Organic matter distribution, Central America

**Perera Nishanthi**, Kotagama Sarath**Challenges in maintaining the Ramsar Wetland of International importance status at Bundala wetland complex in Sri Lanka**

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Poster session P02, Biodiversity science and policy

Sri Lanka signed the Convention on Wetlands in 1971, and in 1990 designated Bundala Ramsar site (BRS) as its very first internationally important wetland. The 6,210 ha BRS is located at the southernmost end-point of the Central Asian Migratory flyway and regularly supports over 15,000 waders. The study is focused on identifying challenges faced by BRS to maintain its ecological character and to implement "wise use concept" recommended by the Ramsar convention.

Ramsar designation had provided benefits, particularly in the form of grants and support for protection and to a lesser extent scientific research and ecotourism. The donor-funded projects had improved the park administration, facilities and have assisted nearby communities in livelihood improvement. Initially declared as a Sanctuary for birds in 1961, BRS was upgraded to a National Park (BNP) in 1992 without looking into human utilization of the wetland resources, which had led to many conflicts. BNP is also considered as an "Important Bird Areas" and is the core area of Bundala Man and Biosphere Reserve. As each of these designations serves a different purpose, multiple designation of the wetland have lead to confusion and inevitably devaluation of the labels. The recent reduction of BNP extent without taking into consideration of different obligations is a good example in this regard.

BRS is also threatened by freshwater influx due to diversion of water for agriculture purposes. The landscape of BRS is changed due to the spread of alien invasive, *Prosopis julifolia* and *Opuntia dilenii*. Although economically valuable, *P. julifolia* is presently being removed in a very unsustainable manner. Three out of the five lagoons are used for salt production and one slattern is located within the BNP. If BRS is to maintain its ecological character as a "coastal lagoon complex" there is an urgent need to address both on site and off-site issues in a more collaborative manner.

**Keywords:** Bundala wetlands, Ramsar convention, Wise use, Ecological character, Multiple designation

**Petersen Caroline**, Purnell Kerry**Biodiversity stewardship as a tool to expand the protected area estate in the Cape Floristic Region**

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Poster session P08, Conservation planning

Biodiversity stewardship is being actively pursued in the Cape Floristic Region as an innovative way of expanding the protected area estate – with landowners signing agreements with the provincial conservation authority to conserve and manage land identified through systematic conservation planning as having high biodiversity and process value.

Stewardship is a powerful new tool to assist national and provincial government in South Africa in fulfilling its mandate to conserve biodiversity outside of state-owned protected areas, in terms of the National Environmental Management: Protected Areas (Act 57 of 2003) and Biodiversity (Act 10 of 2004) Acts – through a consistent, national, landscape-scale approach.

Extension work is guided by a provincial Conservation Action Priorities Map which informs stewardship, land-use planning and decision-making at the local level. The map is based largely on fine scale planning work carried out through the Cape Action for People and the Environment (C.A.P.E.) partnership to conserve the fynbos biome for the benefit of its people. Systematic conservation planning methodology has been used to define Critical Biodiversity Areas needed to conserve biodiversity pattern and process.

In line with other provinces, CapeNature provides three options for stewardship agreements – Voluntary Conservation Areas, Biodiversity Agreements and the most permanently binding, Contract Nature Reserves, of which 33 agreements have been reached in the province

to date. South African National Parks has also recently expanded its mandate to include off-reserve work and is pursuing stewardship through these models as well as the vehicle of Protected Environments.

Stewardship extension work in the fynbos is being carried out on private farms, communal lands, and land owned by government, parastatals and private companies. Management plans involve managing invasive alien species, controlling fires, encouraging sustainable grazing, farming or harvesting, and avoiding further land transformation; with extension assistance and annual auditing by the conservation authority.

**Keywords:** stewardship, fynbos, biodiversity, conservation extension, fine scale planning

**Petersen Caroline, Stafford Louise**

**Cooperative governance as a tool for achieving a strategic approach to alien species management in the Cape Floristic Region**

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Poster session P14, Biodiversity governance

An innovative approach to the coordination of invasive alien species work is being implemented in the Cape Floristic Region through the C.A.P.E. Invasive Alien Species programme, involving role-players from government departments, conservation agencies, academic centres of excellence, non-governmental organisations and private landowners.

This has been possible in the context of the cooperative governance arrangements built up through the Cape Action for People and the Environment (C.A.P.E.) partnership to conserve the fynbos biome for the benefit of its people – one of several bioregional programmes in South Africa that operate in the science-policy interface.

Through this unique partnership, a strategy has been developed for managing invasive alien species in the Cape Floristic Region. The document sets out a framework for a strategic and collaborative approach, integrating science and management to ensure more effective implementation and prioritisation, optimal resource allocation and scientifically sound decision-making.

The partnerships and cooperative governance model are providing the basis for a new style of engagement between government, scientists and conservation managers and an innovative strategy for coordination and best practice.

**Keywords:** invasive alien species, fynbos, invasion biology, cooperative governance, decision-making

**Pettersson Lars B., Samnegård Ulrika, Franzén Markus, Rundlöf Maj, Smith Henrik G.**

**Moths in the agricultural landscape: land management as a key to increased biodiversity in intensively farmed landscapes**

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Poster session P03, Agrobiodiversity

**Background and Goal of Study**

Intensive farming, including the use of inorganic fertilizers and pesticides, is commonly regarded as a major threat against biodiversity in the agricultural landscape. Agri-environment schemes such as organic farming are increasingly being used to counteract negative biodiversity trends. However, the relative success of such schemes needs to be evaluated in ways that take overall differences between e.g., conventional and organic farms into account. Here, we have used such a controlled design to investigate how farming practice affects one of the most abundant, but nonetheless overlooked invertebrate groups of the agricultural landscape: the moths.

**Materials and Methods**

In this study we used matched landscape pairs with one conventional and one organic farm in each pair to investigate if organic management has any effect on moth abundance and diversity patterns. Moths were sampled using bait traps and diversity was analysed at three different levels: a, the mean number of species per trap,  $\alpha$ -within, the mean diversity between traps within a farm, and  $\beta$ -among, the mean diversity between farms.

**Results and Discussion**

We found that organic management does affect moth diversity in the landscape positively.  $\beta$ -among diversity was significantly higher in

organic farms and  $\alpha$  and  $\beta$  within showed a strong tendency towards higher diversity in organic farms. Total moth abundance did not differ between organic and conventional farming. However, we found that the amount of ley in the landscape had a strong and positive effect on moth diversity and abundance at all levels.

### Conclusion

Our results imply that moth diversity can be increased in the agricultural landscape by having more ley in the landscape and more land under organic management.

**Keywords:** agri-environment schemes, conservation, farming practice, additive partitioning, Lepidoptera

**Pham Jean-Louis**, Charrier André, David Jacques, Ronfort Joëlle, Dreyfus Bernard,  
Glaszmann Jean-Christophe

**ARCAD- Agropolis Resource Center for Crop Conservation, Adaptation and Diversity : a new open multi-function platform devoted to plant agrobiodiversity**

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Poster session P03, Agrobiodiversity

ARCAD, short for Agropolis Resource Center for Crop Conservation, Adaptation and Diversity, is a new initiative (2009) supported by Agropolis Fondation and the Region Languedoc Roussillon (France).

ARCAD aims at setting up a new open multi-function (conservation, research and training) platform devoted to the assessment and better use of plant agro biodiversity in Mediterranean and tropical regions.

Understanding how genes, genomes and populations have been shaped by history, environment and societies is a key factor to enhance the quality and sustainability of germplasm conservation and use. The programme's scientific agenda will thus prioritize the study of history and patterns of crop domestication and adaptation as well as the analysis of key parameters underpinning adaptation and diversity structure, at various time scales, through studies of evolutionary genomics, population genetics and social sciences. The research will focus on Phylogenomics, Crop adaptation to climate change and Cereal crops in Africa.

These activities will be complemented with technological and methodological components for the conservation (DNA bank, cryopreservation) and analysis (bioinformatics, linkage disequilibrium) of crop diversity.

A major objective of the programme is also to set up a demand-oriented capacity building platform, based upon the educational facilities offered by universities in Montpellier and the development of specific training modules.

The programme will address issues related to the international policies on plant genetic resource exchange and benefit sharing.

The ARCAD programme was jointly developed by French research institutions and universities: CIRAD, INRA, IRD, Montpellier SupAgro and University of Montpellier 2, in partnership with numerous South and international institutions.

As an open platform, ARCAD will continuously seek the involvement of interested partners that are able to add value to this new programme.

**Keywords:** Agrobiodiversity, Africa, Conservation, Adaptation, Crops

Poirazidis Kostas, **Stefan Schindler**, Vassiliki Kati, Aristotelis Martinis, Dionisios Kalivas, Dimitris Kasimiadis, Thomas Wrbka, Aristotelis c. Papageorgiou

**Conservation of biodiversity in managed forests: developing an adaptive decision support system**

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Poster session P02, Biodiversity science and policy

The increasing exploitation of forests is one of the main reasons of human-induced loss of biodiversity, but conservation strategies are missing in traditional forest management plans. In this study we developed and applied an adaptive decision support system to optimize the conservation of biodiversity in managed forests. We investigated timber production and biodiversity, the main ecosystem services of the Mediterranean forest landscape of Dardia National Park in Greece. Applying 23 environmental variables as predictors, we modeled habitat suitability for four functional groups of organisms, and used totally 351 taxa of plants, 10 species of amphibians, 13 species of small birds and 10 species of raptors for the assessment. We produced maps related to timber production and a series of habitat suitability models for the four functional groups and for overall biodiversity. Applying the decision support system, we integrated biodiversity and timber production under the three management scenarios "Conservation - Maximal ecological benefit", "Timber production - Maximal economical benefit" and "Trade off". Thus, we produced spatially explicit forest management plans that classified the forest stands into four management categories of differing levels of restrictions regarding the timber extraction (i.e. from "free forestry" until "ecological management"). We conclude that timber harvesting and conservation of biodiversity are not necessarily mutually exclusive and that some

rules of temporal and spatial restrictions can optimize their coexistence. We recommend to use habitat suitability models for integrating biodiversity into sustainable forest management, to improve continuously the management by monitoring its effects on forest and wildlife, and to optimize decision support systems by evaluating further key indicator taxa.

**Keywords:** sustainable forest management, biodiversity indicators, management scenarios, habitat suitability models, Dada National Park

**Postl Lisbeth**, Sturmbauer Christian

**Variation of pharyngeal structures in sympatric species pairs and allopatric populations of the rock-dwelling cichlid genus *Tropheus***

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Poster session P06, Biological diversification

Background and goal of study

Lake Tanganyika harbors the oldest and most diverse species flock of cichlid fishes, known to be an excellent subject for the study of explosive speciation and adaptive radiation. The study species *Tropheus* consists of six nominal species all of which live in the upper littoral zone in various kinds of rocky habitats. Over 120 distinctly colored populations are known. In some regions more than one sister species lives in sympatry. This study addresses character divergence of particular viscerocranial bones with known relevance for trophic specialization in allopatric populations and in sympatric sister species. **Materials and methods:** Four sympatric populations of *T. moorii* and *T. polli* were analyzed in comparison to four allopatric *Tropheus*-populations. Preparation of the selected bones (dentary, articular, premaxillary, quadrate, preopercle and pharyngeal teeth) included enzymatic disarticulation of the heads, staining with alizarine red, and applying a landmark system for geometric morphometric analysis on the images taken. Canonical variance analysis (CVA) and principle component analysis (PCA) were used for data analysis, differences between populations were tested using multivariate analysis of variance (MANOVA) and Godall's F – Test for test significance, amongst others. **Results and discussion:** Both, sympatric species and allopatric populations differ significantly in the shape of the dentary and sometimes also in the shape of the premaxillary. The articular, quadrate, and the preopercle did not reveal population-differences in allopatric populations.

**Keywords:** adaptive radiation, geometric morphometrics, viscerocranial bones, adaptive evolution, speciation

Pröpper Michael, **Falk Thomas**, Namwoonde Emilia, Hinz Manfred, Kirk Michael

**How to control the expansion of cultivated fields impacting on biodiversity? Rethinking 'tenure' and 'ownership' - a case study from the Kavango region/Namibia**

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Poster session P14, Biodiversity governance

As in many parts of Africa expansive subsistence agriculture is a major threat for the biodiversity of the valuable Kavango woodlands. 'Tenure' and 'ownership' are closely related key terms in the post-colonial reform discourses about modifying communal property concepts to offer an incentive for landusers to protect biodiversity. The Namibian government is attempting to control the expansion with a hybrid land tenure system replacing traditional allocation practices. 'Ownership' describes a concept of land-users' feelings of responsibility and obligation to protect biodiversity. We analyse if changes in property rights are in the reform context sufficient to reach ownership. **Materials and data** stem from long term anthropological and institution-economic multi-methodological fieldwork, as well as legal case studies focusing on the impact of the customary law system and governance reforms on the security of rights and incentives to protect resources. **Results** indicate that the tenure-setup for Kavango is providing ambiguous incentives for natural resource management, while attempts to raise ownership by empowering people through information and involvement are insufficient. The registration of individual land titles is costly, inflexible to accommodate for common cultural practices such as traditional matrilineal inheritance patterns and social mobility, and is locally rejected. Insufficient communication/trust between statutory and traditional legislative bodies restricts efficient polycentric governance. Statutory and customary agents do not effectively promote ownership in the form of awareness for the values and limitations of resource stocks. Planned reforms decrease tenure security without creating an increase in ownership. The case study shows that institutional adaptations should consider indigenous cultural value systems and need to involve users in negotiations about tenure reforms which then have an increased potential to incite locally owned biodiversity.

**Keywords:** Land registration, matrilineal land tenure systems, customary, statutory law, Kavango, Namibia

**Pulleman Mirjam**, Brussaard Lijbert, Jackson Louise

**Biodiversity in support of sustainable agricultural landscapes and resilient livelihoods; the agroBIODIVERSITY research agenda**

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Poster session P03, Agrobiodiversity

agroBIODIVERSITY is a cross-cutting network of DIVERSITAS dedicated to interdisciplinary science to support the sustainable use of biodiversity in agricultural landscapes.

**Background**

Agricultural expansion and intensification have a detrimental impact on biodiversity worldwide. Vice versa, biodiversity is important for sustainable agricultural production and human livelihoods, including resilience to global change. Managed and unplanned biodiversity in agroecosystems interact with wildland biodiversity within the landscape and affect the provision of ecosystem services at local to global scales. Integration and utilization of biodiversity is proposed to adapt land management to sustainable production and livelihood diversification. However, design, implementation and evaluation of biodiversity-friendly land management requires understanding of the drivers and consequences of biodiversity and land use change. Moreover, there is a need for novel approaches for integrated assessment of biodiversity, ecosystem services and socioeconomic impact at the landscape scale.

**Goal**

Research goals include the development and application of:

- Participatory approaches for analyzing socioeconomic drivers of biodiversity change
- Landscape-level methodologies for integrated assessment of biodiversity, ecosystem services and livelihood performance.
- Approaches for analyzing trade-offs and resilience to global change.

**Methodology**

This work in progress focuses on 7 sites in Indonesia, India, Brazil, Mexico, The Netherlands and California-USA. They represent agricultural landscapes situated at different positions along a biodiversity vs. agricultural intensification gradient. Activities include implementation and evaluation of adaptive land management aimed at sustainable production and biodiversity conservation, in collaboration with stakeholders. Earth observation data, field data and geospatial techniques are combined for methodology development and testing across the sites.

**Keywords:** Biodiversity, sustainable production, ecosystem services, resilience, interdisciplinary science

Queiroz Cibele, **Lindborg Regina**

**From traits to services - an assessment of ecosystem services through plant trait analysis in different land uses**

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Poster session P18, Managing for ecosystem services

**Background**

Changes in land use are currently one of the main drivers affecting diversity. As management of abandoned agricultural land is a major issue in many remote areas, there is a need to view these areas as potentially important for ecosystem services and biodiversity. By addressing diversity through functional traits instead of species richness it is possible to shift perspective from conservation of species to managing their roles in ecosystem dynamics in order to secure and enhance ecosystem services. In this study we analyse how distribution of plant traits relates to different land uses and how changes in these may affect ecosystem services in agricultural and abandoned land.

**Methods**

We assessed the condition for relevant ecosystem services (e.g. meat production, erosion control, carbon sequestration, recreation) in four different land uses; semi-natural grasslands, deciduous forest, pine forest and abandoned field, in two European countries, Sweden and Portugal. We selected a number of traits that were related with functions assumed to be essential for the flow of each specific service. The relative contribution of each species to the provision of a certain service was estimated by using matrixial calculus.

**Results/Discussion/ Conclusions**

Preliminary results suggest that the distribution and abundance of traits vary depending on land use and country. We found that certain traits were more associated to a specific service and land use and that the production of some services was linked by similar trait distribu-

tion. This will have implications on the generation of services as a result of land use changes. A functional trait approach help to understand the biodiversity changes related to land use change and also the changes in the generation of ecosystem services. It may also help to successfully rebuild and restore abandoned and degraded habitats, and indentify potentially new important ecosystem services in these areas.

**Keywords:** agricultural landscape, biodiversity, ecosystem services, land use change, functional traits

### **Rajapaksha Ranil**, Pushpakumara Gamini, Wijesundara Siril, Dhanaekara Upali

#### **A new dimension to pteridological research in Sri Lanka**

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Poster session P19, Systematics and taxonomy

Even though flowering plants in Sri Lanka have been studied extensively, information on Pteridophyte flora is still fragmentary, which is a major impediment to conservation and sustainable management of them. Sri Lanka is reported to have 362 Pteridophytes including 50 endemics. This paper discusses how to enhance our knowledge on Pteridophytes based on the past information and recent research carried out in Sri Lanka. The earliest records of Pteridophyte works in Sri Lanka goes back to period of 1888-1900 and then in 1950-1954 where the checklists and cytology of Petridophytes have been studied. Then there is a gap on Pteridophyte research till recently by the authors. Accordingly, out of 50 endemic Pteridophytes listed in the Flora of Ceylon (2006), only 31 species have identified without any element of doubt as endemic to Sri Lanka. Further, all endemics are concentrated in the remaining fragments of wet zone forests. Discovery of two new taxa (*Cyathea srilankensis* Ranil and *Cyathea x sledgei* Ranil), two 'extinct' species (*Prosaptia ceylanica* Parris and *Drynaria sparsora* (Desv.) T. Moore and three extremely rare species (*Elaphoglossum spatulatum* (Bory) v. A. v. R., *Teratophyllum aculeatum* (Blume) Mett. and *Lindsaea repens* (Bory) Thwaites) indicate that country's remaining fragments of rainforests to be biologically exploited and conserve as priority along with the taxonomy of them. Out of 27 taxa recorded by European Pteridologists (1880-1954), only nine taxa were recorded during a recent study at the Udawattakele forest suggest investigation of Pteridophyte diversity and their changes with time may help to monitoring environmental changes in Sri Lanka. The ongoing study in Sri Lanka involved on morphology, ecology, population and reproductive biology, cytology, molecular investigations artificial germination of spores. Such assessment would bring a wealth of information on Pteridophytes of Sri Lanka while providing the basis to resolve many taxonomic and conservation issues.

**Keywords:** Sri Lanka, Pteridophytes, Endemics, Conservation, Utilization

### **Reu Bjoern**, Kleidon Axel, Mahecha Miguel D., Pavlick Ryan, Proulx Raphael, Schmidtlein Sebastian

#### **Understanding Plant Geography from Functional Diversity and Traits**

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Poster session P12, Biodiversity and climate change

#### **Background and Goal of Study**

Physiognomy of plant forms and physiognomy of vegetation types are closely linked to climate. Additionally, the diversity in plant form and functioning increases towards the tropics. Our research suggests that these large-scale patterns are also highly dependent on trade-off strategies employed at the individual plant level.

#### **Materials and Methods**

Here we use model data of an individual-based plant diversity model that relates climate to feasible combinations of plant functional traits (hereafter functional species). To quantify how climate constrains plant functional diversity, we investigate trade-off structures between twelve model traits using Principle Component Analysis. To determine how global climate regimes results in similar vegetation types, we apply nonlinear dimensionality reduction (Isometric Feature Mapping) on the composition of functional species on a global grid.

#### **Results and Discussion**

Principal Component Analysis shows that in more harsh environments, trade-offs between two or more traits are more influential than in benign environments such as the tropics. This pattern is closely linked to the modeled pattern of functional species richness indicating that ecophysiological trade-offs to climate are the primary mechanism for observed diversity.

The analysis of similarities in the composition of functional species between grid-cells yields a biome-like but gradient derived pattern. This emergent behavior of the model allows for a mechanistic understanding freed from empirical knowledge such as bioclimatic limits for Plant Functional Types.

**Conclusion**

Our results indicate that increasing physiognomic richness towards the tropics as well as the global distribution of vegetation physiognomy can be understood from climate constraining plant functional traits via trade-off processes. We are anxious to compare our findings to those of real world data (e.g. TRY database).

**Keywords:** plant geography, biogeography, ecophysiology, plant functional traits, physiognomy

**Rondon Xanic, David L. Gorchov, Steve R. Elliott****Assessment of Economic Sustainability of the Strip Clear-Cutting System in the Peruvian Amazon**

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Poster session P01, Economics of biodiversity

Strip clear-cutting (Palcazú Forest Management System) is a natural forest management system proposed for the sustainable harvest of timber in tropical forests by clear-cutting long narrow strips (30 x 150m) with harvest cycles of every 40 years. The sustainability of this system, however, has not been evaluated before. We assessed the economic sustainability of this system using two strips clear-cut in the Peruvian Amazon in 1989.

Net present values (NPVs) were calculated for a potential second harvest under three growth models or scenarios: (1) realistic (all light environments), (2) optimistic (higher light, as could be achieved under intensive forest management), and (3) growth potential (fastest growing individuals). For each scenario, we calculated the production and value of timber products (sawnwood, roundwood, charcoal), and their cost of harvesting, processing and transport. The three growth models predicted a production of 1.88 to 22.43 m<sup>3</sup>/ha of sawnwood, 81 to 92 pieces/ha of roundwood, and 11 to 19 ton/ha of charcoal from clear-cut strips. The total value of these products ranged from \$3,112 to \$10,511/ha, assuming that sawnwood was purchased at certified prices. The total cost of harvesting, processing, and transport of timber products ranged from \$3,020 to \$6,167/ha. Net earnings ranged from -\$75/ha to +\$4,344/ha. The NPV of the clear-cut strips with certified sawnwood ranged between -\$73/ha to +\$78/ha at a 15% discount rate, the most realistic rate for Peru.

We conclude that the strip clear-cutting system is not economically sustainable due to slow tree growth, low income from timber products, and high costs for this system. Cutting cycles longer than 40 years may be required to increase timber yields and make this system profitable.

**Keywords:** NPVs, tree growth, timber products, tropical rain forests, Jenaro Herrera

**Rondon Xanic, Cumming Graeme****Using a Predator-Prey model to Simulate Timber Logging in Southwestern Amazonia**

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Poster session P05, Drivers of biodiversity

Land use and land cover change are typically studied at broad scales (using satellite imagery) or at fine scales through empirical data collection and analysis. We present a meso-scale approach to linking across scales for the analysis of regional resilience in a social-ecological system. For model development, we focus on the problem of deforestation in the Amazon. Timber logging is one of the main agents of deforestation in southwestern Amazonia; it is also an important economic activity that sustains the livelihoods of many Amazonian people.

We developed a Lotka-Volterra predator-prey model to simulate the spatial dynamics of a mobile predator, the logger, and an immobile prey, the timber resource, in order to evaluate the long-term stability and persistence of this system. Timber growth is modelled using logistic growth with Holling's functional response II; that is, the timber harvesting rate (predation attack rate) increases in a decelerating fashion reaching a maximum harvesting rate (saturation point), attained at high timber volume. The model is parameterized in a two-dimensional space that represents an area in the southwestern Amazonia, with each cell or forest patch having values for timber volume and logger density. The model is spatially explicit and includes lateral movements of loggers between cells. It is tested against a 20-year time series of land cover change in the MAP (Madre de Dios, Acre, Pando) region bordering Brazil, Bolivia, and Peru.

We assess the potential of the approach for the study of the long-term social-ecological resilience of timber harvesting and livelihoods in southwestern Amazonia. When combined with alternative scenarios and economic data capturing the impacts of the transAmazon highway on transport and commodity costs, this kind of model offers a potentially useful way of linking fine-scale and broad-scale data in a spatially explicit context.

**Keywords:** social-ecological systems, resilience, Lotka-Volterra predator-prey model, spatial model, southwestern Amazon

## **Roseberry Rachel**

### **Post-Disaster Reconstruction: Diversifying Solutions for Biodiversity's Sake**

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Poster session P04, Managing biodiversity with a social-ecological system focus

Rebuilding homes for whole communities which have suffered natural and human-induced disasters poses a myriad of challenges to development organisations. Engaging in environmental measures within post-disaster reconstruction amidst a complex array of other issues is critical, however, if those communities are to strengthen their resilience towards future disasters. Many communities are dependent on their local ecosystems for mitigating floods and landslides, buffering tsunamis and storms, preserving resource based livelihoods, and safeguarding dependable water supplies.

Post-disaster reconstruction following the 2004 Indian Ocean Tsunami in Aceh, Indonesia, exemplifies the case where large-scale efforts to rebuild thousands and thousands of homes has placed enormous pressure on Sumatran biodiversity. The demand for local timber has impacted much of the surrounding rainforests, causing indirect effects on forest communities and particularly large endangered mammals such as tigers and elephants. A similar case can be made for disaster-prone areas in Africa, where reconstruction may impact local biodiversity.

Although each post-disaster context is case specific, this study poses that one solution common to many may be to diversify the methods and materials required of the rebuilding efforts. Such diversification diffuses the impacts on local ecosystems and raw materials. In large-scale reconstruction, a combination of materials and a diversified strategy for material extraction, procurement and even manufacturing methods may help long-term reconstruction goals as well as maintaining local biodiversity.

**Keywords:** post-disaster reconstruction, diversification, environmentally sustainable construction, ecosystem functions, local biodiversity

## **Rudd Murray**

### **Protecting ecosystems and biodiversity: a national priority for Canadians**

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Poster session P04, Managing biodiversity with a social-ecological system focus

As part of a national research project examining the impacts of social science and humanities (SSH) research in Canada, I collected (March 2008) information on the perceived importance of environmental threats (climate change, freshwater quality) and priorities for public investments in, amongst other factors, the protection of the Canadian "environment, ecosystems, and biodiversity". Environmental protection was one of two (along with poverty reduction) top-rated national investment priorities for both citizens (n=1,924 respondents) and SSH researchers (n=366) across the country. The deterioration of water resource quality and/or quantity (groundwater, rivers, lakes, wetlands) was viewed as the number one threat amongst the public (researchers were not asked this question). Climate change was viewed as the number three priority. The results of this study illustrate the importance of ameliorating threats to ecosystem services in Canada and the role of ecosystems and biodiversity in helping to define quality of life for Canadians. The same questions will be asked again in an upcoming Canadian '100 Questions' exercise, thus allowing for an assessment of changes in national priorities following the 2008-09 financial crisis.

**Keywords:** Public investment, research priorities, ecosystem services, threats, public opinion

## **Rutherford Michael, Powrie Les**

### **Understanding biodiversity changes: land degradation in biomes of South Africa**

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Poster session P05, Drivers of biodiversity

**Background and goal.** Land degradation in South Africa is often assumed to reduce biodiversity but has seldom been tested. This study asked how plant diversity changes with severe levels of land degradation in the main rangeland biomes of South Africa. More specifically, 1) does land degradation reduce plant diversity in all the biomes sampled, and what maintains levels of diversity in some degraded systems? 2) which species and growth forms are sensitive to, or tolerant of land degradation?

**Materials and methods.** Plant species composition and canopy cover were recorded on replicated plots at sites that were regarded as severely degraded and on adjacent land in good rangeland condition. Sites were systematically selected in each major biome using SPOT 5 images to identify extreme contrasts in vegetation cover. These sites were confirmed as linked to strongly contrasting grazing pressure and as satisfying specific conditions to minimize potential statistical problems caused by unavoidable pseudoreplicated sampling.

**Results and discussion.** Plant diversity did not decrease in three apparently severely degraded areas under communal tenure in Grassland, Savanna and a grassy form of Nama-Karoo. This was partly through replacement by other species although more than half the species

persisted on the Grassland and Savanna sites. These grass-dominated systems have a long evolutionary history of grazing which may relate to their apparent adaptability and resilience to changed diversity. There was a greater relative loss in species composition in Succulent Karoo and Kalahari Dune Savanna where some species showed apparent local extinction. In Succulent Karoo the loss was strongly balanced by addition of a disturbance-associated indigenous flora some of which may experience apparent local extinction under good rangeland conditions.

Conclusions. Most plant responses to land degradation appear species specific. Plant composition does change but is not necessarily less diverse.

**Keywords:** biodiversity, degradation, grazing, extirpation, biomes

## **Rwego Innocent**

### **Bacterial exchange between humans and wild great apes**

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Poster session P09, Global environmental change and health

Infectious diseases pose a significant and growing threat to the health, well-being and long term viability of wild primate populations. *Escherichia coli* bacteria is used as the model bacterial system to examine whether habitat overlap influences rates and patterns of bacterial transmission between humans and apes. Fecal samples were collected from humans and wild great apes in and around Bwindi Impenetrable and Kibale National Parks, Uganda. The *E. coli* bacteria was genotyped with Rep-PCR fingerprinting and susceptibility to 11 antibiotics measured with the disc-diffusion method. Population genetic analyses were conducted to examine genetic differences between (or among) populations of bacteria from different hosts and locations. Ape populations that overlap in their use of habitat at high rates with people and livestock harbored *E. coli* that were genetically similar to *E. coli* from those people and livestock. Humans had more clinical resistant isolates than livestock and apes. These results suggest that spatial and behavioural overlap between people, domestic animals, and apes can lead to the exchange of gastrointestinal bacteria through the environment. Strategies to limit environmental transmission would benefit human and ape health.

**Keywords:** Antibiotic resistance, great apes, humans, disease, ecology

## **Salas-González Raúl, Fidalgo Beatriz, Gaspar José, Morais Paulo**

### **Monitoring biodiversity in managed forests. Contribution of different forest land cover types for plant species richness**

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Poster session P17, Monitoring biodiversity

#### **Background and goal of study**

The understanding of the contribution of the landscape components for species diversity is essential to support the efforts for biodiversity conservation. For monitoring purposes two research needs are well identified and documented: (1) how patterns of species diversity change across spatial scales, and (2) how the contribution of the different landscape components to the overall species diversity can be assessed. This work shows how the contribution of the different components of the landscape to the overall plant species diversity can be objectively quantified.

#### **Material and methods**

Components of within- and between-community diversity at different scale levels (patch, habitat and landscape) for three diversity measures are derived. The methodology applied comprised: (1) aerial photo-interpretation to identify land cover/use types; (2) multi-scale field inventory to assess plant species diversity; (3) proposition of an additive model for partitioning species diversity.

#### **Results and discussion**

Results showed that forest use dominated land cover. Pine and eucalypts plantations occupied 90% of forest land and broadleaved native species were reduced. One model of species accumulation was successfully adjusted, and a total of 184 species were collected. Diversity augmented from tree to shrub and to herb layer. Significant differences were found for diversity among habitats. Alfa1 and Beta3 were components with higher contribution of diversity at landscape level.

#### **Conclusions**

Management practices are close related to diversity observed. The applied methodology proved to be adequate to estimate the relative contribution of species diversity between landscape components at different hierarchical spatial scales. It has also showed important possibilities to be explored in order to find rapid and cost-efficient indicators for biodiversity monitoring at the landscape level.

**Keywords:** monitoring forest diversity, biodiversity assessment, forest type, habitat conservation, cultivated forests

**Sassen Marieke**, Slingerland Maja, Sheil Douglas, Giller Ken

**Linking forest cover change and its drivers at different levels in Mt Elgon (Kenya/Uganda)**

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Poster session P05, Drivers of biodiversity

**Background and goal of study**

The forests of Mt Elgon, a forested extinct volcano straddling the Uganda/ Kenya border are of high conservation value and form an important water catchment area. The approximately 200,000ha of forest remaining has been protected under various more or less exclusionary management regimes and is surrounded by a dense human population. This study explores how forest cover changes and use of forest resources have been shaped by policies, institutions, and socio-economic drivers.

**Materials and methods**

The forest cover change analysis was based on four Landsat images straddling 1973 to 2009, 15 year old vegetation maps and field observations. The pre-processed images were first classified separately then used to map forest cover change trajectories over time. Relevant documentation provided information on major events and processes that were and are related to changes in forest cover.

**Results and discussion**

Major historical events and causes of deforestation varied from major political upheavals (the Amin regime in Uganda), to large scale plantation schemes and mismanaged resettlement (both countries). More gradual changes were related to socio-economic and institutional changes such as agricultural expansion in and outside the protected areas and the banning of all human activities in Mt Elgon National Park in Uganda since 1993. Further study at the community level will provide information on local land use, forest dependence and the influence of drivers of change at different levels.

**Conclusion(s)**

The study of time series of satellite images in combination with policy developments makes it possible to link drivers and impacts at different levels and is essential to provide understanding of phenomena at local scale levels. The combination with data collection from local communities will provide insights on how processes and impacts at these various levels have led to different conservation and development outcomes.

**Keywords:** land cover change, forest conservation, policy drivers, socio-economic drivers, Mountain forest

**Sattout Elsa j.**, El fadel Mutassem

**Effectiveness of Institutional Framework for Biodiversity Conservation: Will new governance & institutional reform remediate the gaps in implementing strategies & national plans?**

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Poster session P14, Biodiversity governance

The Middle Eastern profile has always been lagging real successes in National Action plans and implementation strategies regarding biodiversity conservation and management. While international funds have promoted the advances in regulatory development and remediation of human impacts infringed on biodiversity and nature, the delay in the issuance of protection laws have hindered biodiversity conservation. Various programs have often not been acted upon by government institutions and hence failed to reflect the effectiveness of international support and commitment to implement an internationally legally binding agreement related to biodiversity because efforts are invariably not imprinted in social, economic and biological status regarding biodiversity conservation and valuation of direct and indirect values. Within this context, this paper examines the Middle Eastern situation regarding agreements related to biodiversity (Ratification, Action Plans and Implementation) and outlines critical facets to develop realistic and applicable solutions to better conserve biodiversity and apply sustainable management taking the country of Lebanon as a typical example and emphasizing 1) the main gaps at the institutional levels hindering the sustainability of internationally funded projects when they end; 2) the root causes of non-effectiveness of the institutional framework: constitutional, political, social or economic; 3) how information gathered and lessons learned are managed and shared among stakeholders; and 4) whether new governance and institutional reforms constitute a necessary facet of the solution.

**Keywords:** Convention on Biological Diversity, Middle East, National Policies, Local Communities, Lebanon

**Schindler Stefan**, Kati Vassiliki, Von Wehrden H., Wrбка T., Poirazidis Kostas

**Testing functional groups and structural indicators as predictors of biodiversity**

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Poster session P17, Monitoring biodiversity

We examined functional groups and structural indicators as predictors of biodiversity in Dadia National Park (Greece), a Mediterranean forest mosaic and local hotspot of biodiversity. Applying three different approaches, we investigated firstly the indicator value of six functional groups (woody plants, orchids, Orthoptera, aquatic and terrestrial herpetofauna, and small terrestrial birds). Secondly, we tested two vertical and four horizontal ecological heterogeneity indices (EHI) and in the third approach, we evaluated the performance of 52 metrics of landscape structure at five spatial scales. Both types of indicators ("functional groups" and "structural indicators") contained some predictors that performed very well and others that performed very poorly. Among the functional groups, woody plants and birds were well performing predictors of overall biodiversity, but in general, we detected low congruence (27% significant pairwise correlations) in the species richness patterns across the groups. Regarding the EHI, each of the six indices was significantly related to overall biodiversity and a particularly good proxy was the combination of one vertical and one horizontal diversity index. The landscape metrics were good indicators of overall biodiversity, as well as of the species richness of woody plants, Orthoptera and terrestrial herpetofauna. Metrics quantifying patch shape, proximity, texture and landscape diversity performed better than those describing patch area, similarity and edge contrast. The scale affected the performance of the metrics as overall biodiversity and the species richness of most functional groups were better predicted by variables considering the close vicinity of the sampling plot only. We recommend that data mining regarding potential indicators is crucial, that landscape heterogeneity is positively related to biodiversity and that the principle of complementarity should be integrated into indicator evaluation and application.

**Keywords:** biodiversity indicators, heterogeneity, landscape structure, landscape metrics, Dadia National Park

**Schumann Katharina**, Wittig Rüdiger, Becker Ute, Hahn-hadjali Karen

**Population dynamics of useful woody species in relation to harvesting practices and traditional protection measures in West African savanna areas**

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Poster session P04, Managing biodiversity with a social-ecological system focus

Most of the people in rural areas in West Africa depend directly on plant resources for their livelihood and maintenance and are particularly concerned by the loss of useful plants. Some of the highly valued species are even traditionally protected and excluded from clearing for land cultivation. For evaluating the sustainability of harvesting practices and traditional protection measures it is essential to investigate the species viability and abundance. To assess the impact of harvesting and traditional protection on population dynamics, we studied two highly valued woody species. One of them, *Adansonia digitata*, is protected by locals, whereas the other one, *Anogeissus leiocarpa* is cut. We studied the size class distribution and the abundance of the species with regard to the degree of harvest in different land use types (village, cropland, fallow) and the protected W Park in Burkina Faso. Interviews with inhabitants were carried out to estimate harvesting practices and the value of the two species for locals. Results show that the villagers use products of the two species in a varied manner. The population structure of *A. digitata* differs significantly between the different land use types. Most of the largest individuals were found in the fallows and in cropland, whereas more small and medium height trees were found in the village area and protected area. In contrast, the population of *A. leiocarpa* does not differ significantly between the land use types and shows an age pyramid. For both species harvesting intensity is more severe in villages and cropland than in fallows and in the protected area due to higher walking distances of the latter. In contrast to the higher harvesting intensity in villages and cropland, recruitment of both species is higher in these sites compared to fallows and protected area sites. This shows that other impact factors such as bush fires, livestock browsing etc. seem to have a higher impact on recruitment than harvesting practices.

**Keywords:** harvesting impact, traditional protection measures, population dynamics, useful woody species, West Africa

**Senbeta Feyera**, Schmitt Christine, Gole Tadesse w., Denich Manfred

**Where does wild *Coffea arabica* grow? The diversity of montane rainforests in Ethiopia**

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Poster session P08, Conservation planning

*Coffea arabica* L. is an indigenous tree to the montane rainforests of Ethiopia. Owing to the land-use pressure, these montane rainforests are heavily fragmented and their area is further decreasing. Deforestation of the forests is not only threatening the forest biodiversity but also the only wild Arabica coffee population's world wide. To assess the floristic diversity and the distribution of wild coffee populations, vegetation studies were conducted in four forest fragments- namely Hareenna, Bonga, Yayu and Berhane-Kontir forests. The majority of the forests with

wild Arabica coffee populations is found in the southwestern highlands of Ethiopia. Vegetation surveys revealed that over 700 plant species belonging to 120 families were found, representing about 10 % of the flora of Ethiopia. In the forests the distribution of wild coffee populations were highly affected by altitude, slope and human influence. The conclusion is that any future conservation efforts to save the wild Arabica coffee populations and the associated biodiversity should take into account multiple-sites conservation approach as the forests are floristically different.

**Keywords:** Conservation, Deforestation, Distribution, Montane forest, wild coffee

**Shaltout Kamal**, El-Bana Magdy, Khalafallah Ahmed, Mosallam Hosny

**Ecological Status of the Mediterranean *Juniperus phoenicea* L. Relicts in the Desert Mountains of North Sinai, Egypt**

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Poster session P08, Conservation planning

#### **Background and goal of study**

*Juniperus phoenicea* L. is the only conifer tree that is restricted to the three mountains of northern Sinai (Egypt). It has been included in the national Red List. To provide a baseline information for its conservation, the present study aims at studying its populations and their associated species at these mountains.

#### **Materials and methods**

Thirty five sites were surveyed on the three anticlines. At each site, the present species and their cover were evaluated, and the number of *J. phoenicea* trees was counted. Tree size index was calculated as the average of its height and diameter. The vegetation of the 35 sites was analyzed using TWINSpan and DCA.

#### **Results and discussion**

The application of TWINSpan and DCA has resulted in identifying four vegetation groups associated with the distribution of *J. phoenicea*, each one occupies a specific geomorphologic unit and topographic gradient. Juniper growth is generally weak at high elevation ( $\geq 900$  m asl) with high proportions of old and dead trees. In contrast, the juniper populations at low elevation (350-470 m asl) seem to be more healthy with high proportion of living foliage and reproductive branches. Differences in the rock type and elevation reflect variations in the recruitment of *J. phoenicea* due to moisture availability.

#### **Conclusions**

The Mediterranean *Juniperus phoenicea* relicts in the Mountains of North Sinai (Egypt) are endangered and its conservation should be a must. Thus, we suggest declaring its natural sites in North Sinai as sanctuaries for conserving it.

**Keywords:** size structure, tree vitality, conservation, North Sinai, Vegetation

**Shao Kwang-Tsao**

**Cryobanking and Fish Barcode Project in Taiwan**

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Poster session P17, Monitoring biodiversity

A "Cryobanking of wild animal genetic materials from Taiwan" project including barcode was carried out since 2005. A total number of 8,700 individuals and 2,440 species, including 1120 species of fish, 115 amphibians and reptiles, 100 birds, 55 mammals and 750 insects, fungi and invertebrates have been deposited at various museums. All specimen data can be browsed from the Taiwan cryobank database (<http://cryobank.sinica.edu.tw>). The condition is that each sample should have voucher specimen with its complete information and all tissue samples need have spared specimens deposited at the Livestock Research Institute, COA.

For the fish work at Academia Sinica, fish barcoding was mainly for the purpose of molecular identification of fish eggs and larval fishes. After a species was confirmed, we can then compile its diagnostic keys and encyclopedia for each morphotype. The spatial and temporal variation of the fish community structure can be better separated if the fishes can be identified to the species level. So far, we have accumulated about 750 COI and cyt b sequences. Based on the preliminary surveys, we noticed that the cyt b gene, in addition to identify population, it can identify species as the COI gene. So we suggest that in the future we should establish a cyt b database. Other applications of fish barcode in Taiwan include species and population discrimination of cutlassfishes and telling apart cods and halibuts at markets; assessing stocks of tuna, eel, mullet, identifying species of flying fish eggs, clupeid larvae, and whaleshark which will be quite useful for fishery management and species conservation.

**Keywords:** cryobank, Barcode of life, fish, taxonomy, molecular identification

**Sharifi Mozafar, Monazah Harsiny Orianab****Sacred Groves in Western Iran: Linking Conservation to Cultural Values**

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Poster session P04, Managing biodiversity with a social-ecological system focus

Key vegetation parameters including species richness, cover, frequencies, abundances canopy stratification, growth form and size groups have been measured for 17 sacred groves in western Iran. Other aspects of vegetation structure such as canopy stratification, growth form and size groups have been measured and compared with available information on natural vegetation cover in the area. These data reveal that sacred grooves in western Iran, compared with similar natural oak forests in the Zagros range are more abundant (higher dominance), more dense (high canopy cover), less diverse (lower species diversity), less spatially homogenous (have lost some of life forms such as scrub and grass species) and suffer from an age structure skewed toward older trees. This study demonstrates that despite a seemingly acceptable practice based on natural-cultural heritages, these groves have no secure future and may be damaged by the same factors that have destroyed oak forest in the Zagros Range. No traditional institution is known to provide any arrangements for preservation of these groves and direct consultation with residents provide no indications other than by tradition these trees are forbidden to be cut.

**Keywords:** Sacred grove, Kermanshah, Kurdistan, Oak forest, Biodiversity

**Shoyama Kikuko****Reforestation of abandoned pasture on Hokkaido, northern Japan: effect of tree-planting on the recovery of conifer-broadleaved mixed forest**

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Poster session P07, Biodiversity and ecosystem functioning

**Background and goal of study**

Forest ecosystems provide enormous benefits for human including maintaining biodiversity. In many parts of the world there are ongoing programs for the management of degraded forest ecosystems. When pasture land is abandoned, there are, in many cases, inhibitory factors that slow the rate of transition to natural vegetation. Accordingly, the planned management of restoration has become an important issue in various parts of the world, where environmental conditions can vary widely. Although tree-planting is widely used as a management tool for restoration, there have been few studies addressing the practical aspects of the procedure. I examined effects of tree-planting within the framework of an evaluation of methods for restoring abandoned pasture on Hokkaido, northern Japan.

**Materials and methods**

I developed and analyzed vegetation maps spanning the past 57 years for the old growth site influenced by artificial disturbance; Markov Cain transition modelling was used to estimate the stationary state of vegetation cover transitions. Furthermore, the field study of vegetation types and changes in species composition over 20 years were carried out.

**Results and discussion**

The sequence of events such as the deforestation of primary forest, abandonment of pasture and the tree-planting campaign arose along with the change in social environment in the country. It was suggested that the veering of land-use national policy caused land abandonment in the local region. The results of analyses suggested that tree-planting have contributed to a reduction in the effects of factors that inhibit revegetation process.

**Conclusions**

The establishment of monoculture plantations is frequently viewed sceptically as a procedure that is applied without fundamental ecological knowledge. For sustainable management of ecosystems, adequate historical and ecological information should be provided to all stakeholders.

**Keywords:** Land use, Restoration, Ecological information, Matrix model, Colonization

**Simaika John P.****Riparian networks mitigate the impact of global climate change**

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Poster session P12, Biodiversity and climate change

Riparian zones provide vital ecosystem services by providing flood storage, improving water quality, reducing pollution and providing habitat and corridors for wildlife. Although riparian zones characterize only a fraction of the landscape, they represent an essential link between terrestrial and aquatic ecosystems. Habitat fragmentation, invasion by alien organisms, water extraction, and pollution all threaten wetland areas. Another major anthropogenic pressure on natural systems is global climatic change. In synergism with habitat destruction, climatic change is considered the greatest threat to global biodiversity. Indeed, future global climatic change is predicted to alter patterns in temperature and precipitation, and therefore the distribution of rivers and wetlands, while the synergistic effect of habitat fragmentation will hamper species abilities to adapt to rapid climatic change. Climate change may also uncouple trophic interactions in aquatic ecosystems. Riparian zones have, however, due to their properties of retaining water and nutrients and regulating temperature, the potential to lessen the impact of global climatic change on riverine biota. This study aims to show the effectiveness of riparian zones in mitigating the effects of global climatic change on stream fauna using dragonflies (Insecta: Odonata) as indicators of ecological integrity.

**Keywords:** biodiversity, monitoring, ecosystem service, climate change, ecological integrity

**Singer Alon, Walczak Margareta, Ur Yair, Golan Sivan, Hadas Rivka****Conservation of rare-endangered and endemic species in Israel**

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Poster session P08, Conservation planning

**Background and Goal of Study**

The Israel Plant Gene Bank (IGB), in collaboration with the Israel Nature and National Parks Protection Authority (NPA) joined together to save rare local plant species. Recently a red book of Israel endangered plant species was published, listing rare as well as endemic species that are declining rapidly, mainly due to destruction of habitats.

**Materials and Methods**

Based on this list, an action plan for preservation was prepared. Each species was surveyed for its appearance in different habitats across the country, rarity level, endemism and the red number index- representing imminent threat of extinction. Consequently, a prioritization-collection list was created.

**Results and Discussion**

After one year collection, seed samples of 90 different species were banked in IGB facilities. It is interesting to note that one species that had been considered to be extinct from the west coast of Israel was located in the Golan Heights. The rest of the samples included 19 species on the verge of extinction found only 1-3 sites in Israel, and additional 61 species which are classified as very rare, found in 4-30 sites. Species with minor seed lots for storage were reintroduced in IGB sites to increase banked samples.

Conclusion: The successful course of this project could act as a key stone towards preservation and possible future restoration programs of the above species of interest at their natural habitats.

**Keywords:** Gene bank, rare species, conservation, endangered species, endemic species

**Smit Hanneline, Robinson Terry, Van Vuuren Bettine, Watson Johan****A new species of elephant-shrew, *Elephantulus pilicaudus*, from the South African Nama Karoo**

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Poster session P19, Systematics and taxonomy

**Background**

Elephant-shrews (*acronym sengis*, order *Macroscelidea*) are small bodied insectivorous mammals with a strictly African distribution.

Seventeen species are currently recognized of which nine occur in the southern African subregion. A newly described *Elephantulus* taxon, *Elephantulus pilicaudus*, is regionally limited to the Nama Karoo of South Africa which borders on two Biodiversity Hotspots, the Succulent Karoo and the Cape Floristic Kingdom.

**Materials and Methods**

Only 17 specimens of the new species are known; three specimens live-trapped in the field and 14 specimens from museum collections. It was compared to the two rock elephant-shrew species with which it co-occurs, and which are morphologically very similar to it, *E. edwardii* and *E. rupestris*, for mitochondrial and nuclear sequence divergence as well as cytogenetic and phenotypic differences. Chromosomal differentiation was identified with the use of standard banding techniques, silver staining and Fluorescent in situ hybridization. The morphological distinction was based on comparisons of the colour of the pelage, dental morphology, a number of standard external body measurements, as well as selected cranial measurements.

**Results and Discussion**

Important genetic distinctions underpin the delimitation of *E. pilicaudus* and support its monophyly based on sequence divergence of two mitochondrial segments and a nuclear intron. The case for the recognition of a new species was strengthened by fixed cytogenetic differences including a centromeric shift, heterochromatic differences on autosomal pairs 1-6, and the number of nucleolar organizer regions. The new species has several subtle morphological and phenotypic characters that distinguish it from its sibling species *E. edwardii*, the most striking of which is the presence of a tail-tuft, as well as the colour of the flanks and the ventral pelage.

**Conclusion**

Concerted efforts should be made to assess the relative abundance of *E. pilicaudus* and to determine potential threats to its habitat.

**Keywords:** Sengi, South Africa, Taxonomy, Endemic, Conservation

Snaddon Jake L, Turner Ed C, Foster William A, **Godbold Jasmin**

**Changes in arthropod diversity and ecosystem function: from rainforest to oil palm plantation**

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Poster session P07, Biodiversity and ecosystem functioning

Worldwide tropical ecosystems are under increasing threat from exploitation and land-use change; particularly in Southeast Asia, where the relative deforestation rates are the highest of any tropical region. One of the main drivers of deforestation in the region is the expansion of oil palm plantations. Here we report from a study, carried out in Sabah, Malaysia, investigating the effects of forest conversion on the arthropod diversity and leaf-litter decomposition across primary forest, selectively logged forest and oil palm plantation. Two subhabitats; the forest floor and a common epiphyte (Bird's Nest Ferns, *Asplenium* spp.) were sampled. Leaf-litter decomposition was measured at 30 sites in each of the habitats using the litterbag technique. Litterbags were 5 cm by 5 cm and made from nylon mesh with a 4.5 mm hole, which allowed the entry and exit of arthropods. Litterbags were collected from the field after 280 days. The arthropod community was sampled in the same sites and at the same time as the litterbags were collected. The arthropods were extracted from the forest floor and fern material using Winkler apparatus. As a result of the conversion of forest to oil palm plantation there were significant declines in the arthropod abundance and diversity. This decline was more apparent between the invertebrate communities of the forest floor than in the ferns. Leaf-litter decomposition rates were also significantly lower in the oil palm plantation. However, the decline in the decomposition was more apparent in the oil palm ferns than on the forest floor. The maintenance of the high rate of leaf-litter decomposition in the forest floor sites of the oil palm plantation was due to a single termite species, *Macrotermes gilvus*. This finding emphasizes the importance of species-specific traits in influencing ecosystem functions particularly in degraded ecosystems.

**Keywords:** oil palm, arthropod, decomposition, ecosystem function, agrobiodiversity

Solan Martin, Bulling Mark, Dyson Kirstie, Raffaelli Dave, Paterson Dave, Piran White,

**Jasmin Godbold****Interactions between habitat configuration and species behaviour alter ecosystem processes in the marine benthos**

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Poster session P07, Biodiversity and ecosystem functioning

The widespread and large scale decline in biodiversity and the resulting losses in ecosystem services are currently causing much concern, and are the focus of extensive research efforts. Environmental heterogeneity is known to affect many population and community processes and is therefore likely to have a critical influence on biodiversity – ecosystem process relationships. However, experiments so far have ignored this heterogeneity in an effort to control for possible confounding factors. Here, using an experimental mesocosm approach with marine sediment invertebrates, we show that environmental heterogeneity can strongly influence levels of nutrient release. Nutrient release occurs primarily as a result of sediment particle movement induced by invertebrate activity. Our analysis indicates that the main

mechanism through which environmental heterogeneity acts on these ecosystem processes is by influencing levels and directions of faunal movement. However, this is only part of a more complex set of interacting drivers including density-dependent movement and interspecific interactions. There was also variation between species in the extent of the influence of heterogeneity on their movement, suggesting that the scale at which heterogeneity occurs may be a further strong influence on biodiversity – ecosystem process relationships. Our results indicate that previous studies examining the relationship between biodiversity and ecosystem function in homogenous experimental systems may provide an incomplete understanding of the consequences of biodiversity loss in natural systems.

**Keywords:** Ecosystem function, biodiversity, habitat heterogeneity, movement, marine benthos

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Granados Barba Alejandro

**Biodiversity in the benthic macrofauna of Sacrificios Reef lagoon, Veracruz Reef System, Mexico**

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Poster session P13, Analysing patterns and trends

#### **Background and goal of study**

Sacrificios is a small island of the Veracruz Reef System (which includes 23 reef structures), close to the large city and port of Veracruz, very popular for tourism and recently declared National Marine Park. Strong environmental seasonal stress adds to the anthropic impact due to vigorous urban, industrial and tourist growth of nearby Veracruz. Closed for almost 20 years and recently reopening to visitors, there is almost no information about its marine habitats: fringing reefs, seagrass beds and soft bottoms. Biodiversity studies and ecological assessments are urgently needed. To this aim, in this study we evaluated the diversity of the benthic macrofauna of the main habitats around Sacrificios.

#### **Materials and methods**

Twelve stations in four radial transects were sampled with an underwater suction sampler (13.22 dm<sup>3</sup>) inside the reef lagoon, in sandy soft bottoms, seagrass beds and coral patches. Macrofauna was determined to species level; density, species richness and alpha and beta diversity were calculated for each habitat.

#### **Results and discussion**

Polychaetes dominated (77 species, 372 ind/dm<sup>3</sup>) representing 82.5% of the total fauna. We herein report 122 new records of species for the area and 15 potentially new species. Highest diversity values were found to the east, in sands and seagrass beds. The dominant *Mediomastus californiensis* and *Spio pettiboneae* are characteristic of areas with high organic matter content in sediments, while *Paramphionome jeffreysii* and *Syllis botosaneanui* also dominant, are common in reef habitats.

Species turnover was marked between seagrasses and corals (beta diversity values of 0.75 to the east; 0.82 to the west and 0.75 to the northeast), but very low between sands and seagrasses.

#### **Conclusions**

The area is recovering from past abuse thanks to preventive measures; this first monitoring will provide guidelines to policymakers in their decisions about its management.

**Keywords:** benthos, macrofauna, biodiversity, indicators, Veracruz

**Sommer Simone**, Meyer-Lucht Yvonne, Puettker Thomas, Pardini Renata

**How important is the maintenance of adaptive genetic variation in conservation? Immune gene diversity and population health in two mouse opossums from the Brazilian Atlantic forest differing in their**

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Poster session P09, Global environmental change and health

#### **Background and Goals**

The Brazilian Atlantic Forest is one of the most endangered biodiversity hotspots threatened by ongoing habitat loss and fragmentation. In the course of fragmentation populations get isolated and are in consequence likely to lose genetic diversity. Thereby, effects on the genetic constitution might differ among species depending on their tolerance to fragmentation. Numerous studies emphasised the importance of

genetic variation on the adaptive potential of a species to a changing environment and in disease defence. In placental mammals, genes of the immune complex (MHC genes) are especially important. However, in marsupials very little is known about natural levels of MHC polymorphism and their functional importance in population health.

**Material and Methods:** We compared two species of mouse opossums (*Gracilinanus microtarsus*, *Marmosops incanus*) inhabiting fragments of the Brazilian Atlantic Forest in terms of MHC class II diversity and measured non-invasively the gastrointestinal parasite burden. The species differ in their tolerance to habitat fragmentation.

### Results and Discussion

Our study pointed out for the first time the functional importance of MHC class II diversity in disease defence in natural populations of marsupials. The fragmentation-sensitive species had a very low MHC diversity associated with higher parasite loads. The more tolerant species *G. microtarsus* showed a tenfold higher population wide MHC diversity and lower parasite prevalence.

### Conclusion

This study emphasise the important of maintaining MHC diversity which should be considered in conservation management plans.

This studying is part of the Brazilian/German cooperation project 'BioCAPSP - Biodiversity Conservation in a fragmented landscape at the Atlantic Plateau of São Paulo' funded by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and the German Federal Ministry of Education and Research (BMBF).

**Keywords:** Brazilian coastal rainforest, Fragmentation, Parasites, Adaptive immune gene variability (MHC), Marsupials

## Sommerwerk Nike, Tonolla Diego, Hering Daniel, Freyhof Jörg, Tockner Klement

### Current state and future trends of Europe's lifelines

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Poster session P13, Analysing patterns and trends

### Background and Goal of the Study

Freshwater ecosystems have been subject to multiple anthropogenic stressors. As a consequence, their habitats and species have undergone greater loss than in terrestrial, coastal or marine ecosystems. Within the next decades, considerable change in climate, land-use urbanization and fragmentation is expected. There has been an acute lack of comprehensive data on the distribution of freshwater species. The goal of the "European catchment database on freshwater biodiversity" is to provide quantitative data on catchment parameters and environmental status (hydrology, water temperature, land use, water stress) in combination with species diversity patterns (wetland birds, amphibians, fish, odonates, and crayfish) for all of Europe, western Russia, Caucasus and Anatolia.

We now have information for a total of 165 catchments, covering 72% of the European continent, included in the data base. It has been implemented in MS Access and is linked with GIS-layers. Currently a "European Catchment Pressure Index" is calculated for each catchment that builds on data such as i) land use, ii) water stress, iii) river fragmentation, iv) socio-economic and v) proportion of non-native fish species.

### First Results

First analyses of the data show that more than 75% of the European catchments are classified as heavily impacted and thus are likely to threaten freshwater biodiversity. Up to 40% of native fish species have disappeared at the catchment scale, especially long-migrating species such as sturgeons (Acipenseridae). The share of nonnative fish species exceeds 40% in some catchments, particularly on the Iberian Peninsula and the Atlantic region of France.

### Conclusions

The database enables i) the establishment of ecosystem-based indicators of ecological status, ii) the setting of priorities for conservation and management at the catchment scale as well as iii) the development of biodiversity scenarios under rapidly changing environmental conditions.

**Keywords:** European river catchments, freshwater biodiversity, environmental pressures, conservation strategies, restoration strategies

**Sousa Pinto Isabel**, Vieira Raquel

**European network for monitoring intertidal biodiversity with schools**

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Poster session P17, Monitoring biodiversity

The intertidal zone offers great educational and scientific opportunities for young students to learn more about marine life. To detect changes and to forecast how communities will develop there is the need of series of biodiversity and environmental data that span for a long period of time, over a wide geographic range and with some detailed observations in many different points. As part of Marbef's Outreach program, a pilot project to monitor intertidal biodiversity with schools was developed in Portugal, involving Cimar, a Marine Research Centre from University of Porto and ten basic and high schools and other voluntary groups. Each participating school is responsible for the collection of data at a particular beach with the help of researchers from Cimar. The data: e.g. species lists, abundances, temperature and salinity and the presence of garbage or other sources of pollution, is recorded in a database that is online. The students can compare their data with data from other schools, other years and so on. The program was recently extended to other countries, aiming at having possibilities of comparing data and experiences, have exchange of students and teachers from different countries and having an European monitoring program with similar protocols to allow easier use of data at larger scales. The possibilities and limitations of this program and of the use of data obtained are analysed.

**Keywords:** Marine, Biodiversity, Outreach, Monitoring, Long-term data

**Sridhar Aarthi**, Menon Manju

**The Influence of Coastal Legislation on Marine Biodiversity and Communities in Tsunami-Affected Mainland India**

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Poster session P14, Biodiversity governance

**Background and goal of study**

Coastal biodiversity conservation in India has been attempted through a range of legislations. Of these, the Coastal Regulation Zone (CRZ) Notification enacted by the Ministry of Environment and Forests (MoEF) in 1991 is most significant for the integrated protection of about 8000 km of coasts. Following the Indian Ocean tsunami in 2004 enormous attention was focused on the law's influence on mitigating its impacts. The MoEF now proposes a new law revising the structure, provisions, approach and perspective of the CRZ Notification. Our paper traces the evolution of coastal legislation in the country, its role in the tsunami's impacts, and the implications of the MoEF's future plans.

**Materials and methods**

The analytical framework involved examining its operation against specific parameters under three indices of Protection, Governance and Efficiency. We undertook content analysis of various legal and official documents, semi-structured interviews with key informants and examined the influence of significant political, economic and social events over this law.

**Results and discussion**

Details of the law's operation are provided which illuminate its role against the above-mentioned indices. Our results show a growing influence of economic entities over the State in shaping environmental legislations, against the waning influence of NGOs and people's organizations. The focus of policy change is on legal text and lesser on delivery mechanisms. We explain how such influence is exerted and provide projections for coastal communities and ecosystems.

**Conclusions**

We conclude that coastal management has thus far been significantly and poorly tailored and patchwork revisions to the law lend little credibility of its protective powers among stakeholders. However public opinion on the subject is high and provides an opportune moment for undertaking a participatory and scientific exercise on coastal legislation.

**Keywords:** coastal management, legislation, India, marine biodiversity, CRZ

**Swamy Savitha**, Devy Soubadra

**Neighbourhood parks and ecosystem services in Bangalore, India: does size matter?**

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Poster session P18, Managing for ecosystem services

In India, most conservation efforts are towards forested landscape and there is lack of emphasis on urban green space and its biodiversity related service. While, large green spaces within cities seem to get protection and support of both ecologists and citizenry, small neighbourhood parks are often ignored. It is increasingly being realised that to develop new parks and build stewardship towards green spaces and urban biodiversity understanding people's attitude and perception towards them is essential. The aim of this study is to evaluate small green spaces within the city for the biodiversity and recreational services they provide to the citizenry groups and also study attitudes and perceptions of the communities towards these parks.

All neighbourhood parks in Bangalore are identified and mapped using GIS and remote sensing techniques. These parks are further categorized into 3 size classes to estimate if there is a critical park size that would support biodiversity and provide recreational services.

Biodiversity will be assessed using key taxa such as birds and butterflies. A biodiversity fondness survey; attitude and perception survey will be conducted among park users and beneficiaries, and those who seek alternate options such as gyms and do not use parks.

Preliminary results show that people are fond of birds and butterflies, mainly because of their charismatic appearance. Small parks seem to support unique migrant bird species and a mix of wooded and open area butterfly species. Attitude survey revealed that people perceive only large parks to provide ecosystem services than small and medium parks.

This study would help in building stewardship among the citizens to develop parks which provide recreational services and support biodiversity. Long term goals would be to bring in local governing bodies, corporate, citizenry groups to collaborate and develop a co-management plan to conserve Bangalore's biodiversity rich green spaces.

**Keywords:** Neighbourhood parks, Biodiversity, Ecosystem services, urban green spaces, citizens

**Swemmer Anthony**, Kohi Edward

**Savanna tree and bird diversity in rural versus protected areas**

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Poster session P08, Conservation planning

**Background and goal of study**

Communal lands surrounding rural villages are the most common land-use in the savanna biome of Africa. These areas provide vital natural resources (such as fuelwood), but continuous harvesting has led to concerns over losses of biodiversity. Recent increases in elephant numbers in conserved areas has raised concerns that biodiversity losses may also be occurring in these systems, due to a loss of large trees. An impact of frequent burning is also suspected. In order to assess these threats to biodiversity, long-term monitoring plots were recently established at sites in the Kruger National Park, and nearby communal lands.

**Materials and methods**

Plots were established at sites within Kruger exposed to various combinations of herbivory and fire. Sites in the nearby communal lands were located on the same soils and experience the same rainfall. Tree species are recorded in these plots annually, as are seedlings. Bird diversity is currently being surveyed at each site.

**Results and discussion**

Comparisons of the protected areas and communal lands revealed similar results to those obtained almost 2 decades earlier - no reductions in tree species richness. Although some differences in evenness were evident. While seedling numbers suggest that many species could disappear due to lack of recruitment, the ability of all species to resprout has led to their persistence through many decades of harvesting. Regular burning within the protected area has resulted in large declines in species richness. Elephants have increased tree mortality, but have yet to produce significant reductions in tree diversity. Results of bird diversity are pending.

**Conclusions**

Communal lands show large structural changes in vegetation, but significant differences in tree diversity are not evident. In contrast large reductions in diversity can occur in protected areas, with fire currently having stronger impacts than elephants.

**Keywords:** fuelwood, elephants, fire, woody vegetation, avifauna

**Takashi Osono**, Dai Hirose

**Species richness and host specificity of ligninolytic fungi associated with leaf litter decomposition in a subtropical forest in Japan**

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Poster session P07, Biodiversity and ecosystem functioning

Fungi play central roles in lignin decomposition in leaf litter in forest ecosystems. They are especially important in tropical forests where the decomposition of lignin in leaf litter is responsible for the rapid turnover of carbon and essential nutrients in the soils. However, there has been scant information regarding the species richness and host specificity of ligninolytic fungi associated with leaf litter decomposition in tropical and subtropical forests. To demonstrate this, we isolated in April and July 2008 a total of 116 fungal isolates from leaf litter of 18 tree species in a subtropical evergreen broad-leaved forest in southern Japan. These isolates were isolated with the surface-disinfection method from bleached leaf area in which fungal colonizers decomposed lignin selectively in leaf tissues. The 116 isolates were inoculated onto sterilized leaf pieces under a pure culture condition and verified their bleaching activity. The nrDNA ITS sequences were then determined for the 116 fungal isolates to analyze their phylogenetic relationship. Seventy-six (66%) of the 116 isolates were in the Xylariaceae (Ascomycota), followed by 28 isolates (24%) in the Tricholomataceae (Basidiomycota), and 10 isolates (9%) in the Rhytismataceae (Ascomycota). The 76 xylariaceous isolates were divided into 17 operational taxonomical units (OTUs) according to phylogenetic analysis. The most frequent OTU1 (25 isolates) and OTU2 (14 isolates) were isolated from leaf litter of 10 and 8 tree species, respectively. The results show that the species richness of ligninolytic fungi in the study site is relatively high and that the host specificity of ligninolytic fungi is generally low. To our knowledge, this is the first study to demonstrate the species richness and host specificity of ligninolytic fungi in forest soils of tropical and subtropical regions.

**Keywords:** Decomposition, Fungi, Lignin, Biodiversity, Phylogeny

**Teegalapalli Karthik**, Hiremath Ankila, Jathanna Devcharan

**Patterns of seed rain and seedling regeneration in abandoned agricultural clearings in a seasonally dry tropical forest in India**

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Poster session P03, Agrobiodiversity

**Background**

Forest recovery in abandoned pastures and agricultural fields is often impeded; therefore it is important to understand the factors limiting regeneration.

**Goal of study**

We investigated the patterns of seed arrival and the patterns and spatial correlates of regeneration of woody species at different distances from surrounding forest.

**Materials and methods**

In the year 2006, patterns of seed arrival in five four-year old abandoned agricultural clearings nested within a seasonally dry tropical forest in India were examined at different distances along five transects radiating from the forest edge into the clearings.

**Results and discussion**

5,563 wind-dispersed seeds and 706 mammal-dispersed seeds of 19 and 11 tree species, respectively, were recorded. Wind-dispersed seeds were overrepresented in clearings relative to mammal-dispersed seeds and their numbers declined steeply with increasing distance from forest. Seeds of the invasive shrub *Chromolaena odorata* were abundant in clearings. Vegetation in the clearings was also recorded and seedling and sapling densities of tree species declined linearly with increasing distance into clearings. Although the arrival of wind-dispersed seeds outnumbered that of animal-dispersed seeds, seedlings and saplings of the latter were three times more abundant in the clearings.

**Conclusions**

Regeneration recorded in the clearings suggested that they are likely to revert to forest over the next few decades. However, regeneration may be impeded by *C. odorata* invasion as indicated by the high rates of seed dispersal and the effect of weed cover on regeneration. Regeneration of woody species and *C. odorata* cover in these clearings will be recorded in the year 2009 to compare composition in terms of dispersal modes and *C. odorata* cover, 4 and 7 years since abandonment. This comparison can provide important insights to vegetation recovery pathways in clearings nested within seasonally dry tropical forests.

**Keywords:** agricultural clearings, regeneration, *Chromolaena odorata*, seasonally dry tropical forests, seed dispersal

**Tekpetey Stephen****Impact of climate change on forest biodiversity in Ghana: Indicators and implication for medicinal plants status**

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Poster session P12, Biodiversity and climate change

**Background**

The forest zone of Ghana, at the turn of the last century had a lot of endemic flora and fauna with numerous goods and services for the human populace in the country. In recent times, only about 11.8-14.5% of the original forest cover is left with illegal logging cited as a major contributing factor. In the wake of climate change, the quality of genetic biodiversity in Ghana has been predicted to change significantly. Limited knowledge exist on the effect of climate change to the status of medicinal plants in Ghana. This paper aimed at assessing the indigenous knowledge on the impacts of climate change to the status of some important medicinal plants in southern Ghana.

**Material and methods**

Traditional indigenous knowledge of the indicators of climate change and its impacts and implication were understudied in selected some communities (10) in Southern Ghana. This was done through literature search and interviews and focus group discussions among selected communities that engage in medicinal plants.

**Results and Discussion**

Preliminary results indicate that the status of most of important medicinal plants important for primary health care in the selected communities has diminished significantly over the past two decades. The implication for primary health of the rural poor was highlighted. Furthermore, the observed change in the timing and intensity of rainfall in the selected communities as indicated by IPCC indicators of climate change recent will further stress the provision of the quality traditional medicinal plants.

**Conclusion**

The change in climate will certainly affect the diversity of medicinal plants at different degrees and concrete steps by all stakeholders are needed to alleviate the predicted effect.

**Keywords:** medicinal plants, climate change, forest, biodiversity, forest science

**Tewari Anil****Role of some native plant species in respect to biodiversity conservation and eco-restoration of Vindhayan hill range near Allahabad (u.p.) India**

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Poster session P15, Ecological restoration

**Background and goal**

The case study focused on eco-restoration work being done by various agencies in the Vindhayan hill range; clearly indicate the fact that the results are far from satisfactory. This is due to the fact that the fault exists well within the strategy of the implementation of their programmes, which certainly requires immediate rectification. Some of the local plant species like *Butea monosperma*, which is also known as the "flame of the forest", show a number of unique adaptive features, which have been taken into account in the present study. The genetic plasticity of the plant has been assessed and evaluated.

**Material and methods**

An extensive survey of the affected area has been done since 1986 and a comparative study of degraded and non-degraded areas has been conducted in respect to all possible ecological parameters with the help of standard ecological techniques and methods. Samplings of plant material have been done through standard approaches suitable to the prevailing ground conditions. All possible information has been collected about the area from the authentic sources.

**Findings and conclusion**

*Butea monosperma* observes the family- planning norms and so the name monosperma has been given to it. Its flower is beautiful in appearance, so the name Butea has been assigned. The plant show a number of unique adaptive features which have been studied in detail. It has been found that the plant has all those potential which are required in a plant to be considered as a suitable plant species for the eco-restoration.

tion of degraded forest ecosystem of the Vindhayan hill range. The economic value of the plant has been also evaluated, which suggests that the plant can support long term self-sustaining afforestation activities in the region. It produces a number of products which can serve as a raw material for local industry.

**Keywords:** Eco-restoration, health and herb, exotic, ethics, sustainable

**Tillier Simon**, Häuser Christoph, Berendsohn Walter, Enghoff Henrik, Kriegsman Leo,  
Roberts David Mcleod

**Making taxonomy available for conservation efforts: the EDIT network**

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Poster session P08, Conservation planning

Measuring biodiversity change implies a sound basis of taxonomic knowledge, which involves both having enough trained taxonomists and making taxonomic information available. The European Distributed Institute of Taxonomy (EDIT) aims at overcoming the taxonomic impediment through collaboration, integration and a joint work programme (<http://www.e-taxonomy.eu>). It includes 24 major European scientific centres in taxonomy, along with Russian and US partners.

To foster links between taxonomy and its users, EDIT will create and maintain a list of taxonomical expertise and ways to reach it, in order to help users find the relevant taxonomist partner to support their effort.

EDIT is already organising the taxonomic survey of important areas in Europe, starting with programmes in the Mercantour (France), Alpi Maritime (Italy) and Gemer (Slovakia) national parks. In this way, we increase taxonomy's relevance to the study and conservation of the world's biodiversity. We also make it scientifically viable, based on protocols which allow repetition and measurement of change. Beyond acquisition of data, the goal of EDIT's ATBIs is to foster new methods for working in a more collective way, and new techniques to process the information from the field to the users, including DNA barcoding and databasing.

EDIT facilitates science in the field and the lab, with web-based tools for taxonomists and other conservation workers. We support common work through new communication methods, to coordinate large-scale research relevant to global biodiversity indicators. We have launched an Internet Platform for Cybertaxonomy, which will make the various components of the taxonomic activities and infrastructures interoperable, and will make tools openly and freely available. The EDIT activities contribute to building up LifeWatch, the project for a new European very large distributed infrastructure for biodiversity information and analysis, and to the overarching GBIF.

**Keywords:** Global Taxonomy Initiative, Biodiversity loss, Collections, Expertise, IT

**Torres Paulo**, Costa Ana, Ávila Sergio, Chainho Paula, Costa Maria

**Inspect for marine aliens in the Azores**

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Poster session P05, Drivers of biodiversity

The introduction of alien species is an issue of global concern due to severe impacts such as biodiversity loss and serious damage to economy and health development. Besides natural pathways, various anthropogenic factors, such as hull fouling, ballast water, fisheries, aquaculture and recreational boating, contributes for the entrance of marine species in areas outside their natural biogeographic range. Similarly to other European countries, records for alien species in Portuguese waters have been gradually published but systematic registers or databases are not available. To increase our knowledge regarding non-indigenous marine species in the Portuguese coast, Ponta Delgada marina, harbour and adjacent areas are being surveyed for invasive species. Fouling communities are being sampled on subtidal rocks, floating docks and permanent pontoons, and in floats (ropes, wires, buoys, floats, and tires). Underwater samples are obtained by SCUBA diving. Also, ballast water from ships travelling on the Azores-mainland route is being collected and analyzed. Hence, this study was designed to identify current established marine alien species and potential new invaders in the Azores also aims and to clarify some aspects of the introduction processes, such as the identification of environmental conditions that favour or inhibit invaders, species with enhanced invasive characteristics and evaluate the importance of several entrance vectors (e.g. ballast water and fouling hulls). This study is part of a larger national project INSPECT (Introduced marine alien species in Portuguese estuaries and coastal areas: patterns of distribution and abundance, vectors and invading potential) under which surveys are being conducted in different estuarine and coastal systems, namely in Tejo and Mira estuaries, the harbours or marinas of Sines, Lisbon, V.N. Milfontes, and Ponta Delgada (Azores), neighbouring areas and some selected ship ballast water tanks arriving to the mentioned harbour.

**Keywords:** alien species, introduction vectors, harbours, marinas, Ponta Delgada

**Triponez Yann**, Schatz Bertrand, Alvarez Nadir

**Lineage boundaries among the Fly Orchid group (*Ophrys insectifera* s.l.): consequences of an intricate evolutionary history on conservation strategies**

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Poster session P06, Biological diversification

**Background and Goal**

The *Ophrys* genus is among the most intriguing orchids distributed in the West-Palearctic. By developing flowers imitating female bees via different sensory clues, these rewardless orchids lure hymenopteran males that carry pollen from one flower to another. Whereas the genetic identity of most *Ophrys* taxa has not been clearly defined until now, several species are currently considered as endangered in European countries due to recent human pressures on its habitat. In order to circumscribe species status and disentangle spatial genetic structures for further application to conservation guidelines, we focus here on the Fly Orchid group, which comprises the widespread *O. insectifera* s.s. and its sister species *O. subinsectifera* and *O. aymoninii*, two characteristic representatives of the endemic Floras of Spain and France respectively.

**Material and Methods**

Taxa were sampled throughout more than 50 populations across Europe. DNA sequencing of two ultra-variable chloroplastic regions as well as preliminary AFLP fingerprinting were carried out on the whole dataset and both phylogenetic and clustering analyses were performed.

**Results and Discussion**

Although genetic variation was detected whatever marker considered, no clear genetic structuring was addressed neither according to the morphologically recognized taxa, nor to the origin of samples. Might this pattern be explained by the extreme dispersal abilities of *Ophrys* micro-seeds? Is the phenotypic plasticity the only responsible for the morphological differentiation of endemic taxa in particular environments? We will discuss these questions by considering our fine-scale AFLP results in the context of conservation biology.

**Conclusion**

Our study shows that, as probably for many other orchid species, optimized conservation means should rely on the biological and genetic knowledge of the most consistent species concept as well as on the genetic structure of gene pools throughout a species distribution.

**Keywords:** cheating pollination, conservation status, Orchidaceae, phylogeography, species concept

**Twine Wayne**, Hunter Lori

**HIV/AIDS mortality, household use of biodiversity, and food security in rural South Africa**

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Poster session P09, Global environmental change and health

**Background and goal of the study**

Rural households in sub-Saharan Africa use biodiversity to cope with shocks and stresses. HIV/AIDS is a key household shock in the region, yet the role of biodiversity in human wellbeing among households impacted by HIV/AIDS is largely unexplored. We investigated the relationships between AIDS-related adult mortality, household use of biodiversity, and food security in rural South Africa.

**Materials and methods**

The study was conducted in the Agincourt Health and Demographic Surveillance Site (AHDSS), Mpumalanga Province. Food security and resource use were quantified for 290 households using a survey questionnaire. Households were randomly drawn from the AHDSS database, stratified by the occurrence of a recent adult death (AIDS n=109; quick non-AIDS n=71; no death n=110). Response variables were compared statistically between mortality strata, controlling for household size and wealth status. Results and discussion: Food security was generally lower among households with a recent adult death, although the impact of poverty was often more pronounced than the mortality effect. Mortality-impacted households were not more likely to use wild foods than their non-mortality counterparts, probably due to diminished human capital. However, the consumption of wild foods such as edible insects improved some indices of food security among user households. Mortality-impacted households were much more likely to use biodiversity to save money. We found few significant differences in food security and resource use between AIDS-impacted households and those with a sudden non-AIDS death.

**Conclusion**

Adult mortality can seriously impact household food security. HIV/AIDS is not unique in this regard, but it is the leading cause of death among prime-age adults in the region. The use of biodiversity plays an important 'safety net' function, but it does not adequately mitigate the impacts of poverty and adult mortality on food security.

**Keywords:** HIV, AIDS, Food security, livelihoods, resources, rural

**Van Oudenhoven Frederik, Eyzaguirre Pablo****Bridging managed and natural landscapes: the role of traditional (agri)culture in maintaining the diversity and resilience of natural ecosystems**

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Poster session P04, Managing biodiversity with a social-ecological system focus

The conservation of 'wild' biodiversity and agricultural biodiversity have traditionally been treated as separate domains, the former that of protected reserve areas, the latter, at least its in situ aspect, that of farms, orchards, the domesticated habitat of human communities. But as the continued conversion of natural landscapes into managed, agricultural ones is beginning to dilute the physical boundaries between them, so conservationists have begun to call for a new, more integrated approach to their conservation: humans, for better or for worse, are now part of the large majority of natural ecosystems and their drive for development had better be harmonized with the aims of conservation.

Using insights from historical and political ecology, we explore in more depth the evolution and conservation of such 'hybrid' landscapes as they have been discussed in research over the past 15 years. The discussion focuses on two related themes: firstly, the process of crop selection and domestication in traditional communities, the socio-cultural criteria that inform this process, and the extent to which it facilitates the exchange of domesticated genetic material with the wild (or with wild material). Secondly, the role that human agency -- through a mix of cultural preferences, lifeways, social and institutional arrangements and agricultural practices -- plays in the evolution of natural landscapes and their diversity.

Our analysis sheds light on the practices and conditions whereby human communities with deep cultural roots in an ecosystem and landscape can have positive impacts on the integrity, richness and sustainability of ecosystem functions and services, and advocates a more thorough consideration of their role in the management of biodiversity in general and protected areas in particular.

**Keywords:** biodiversity conservation, agriculture, hybrid landscapes, protected area management, man and biosphere reserves

**Vazquez Patricia Susana, Kristensen María Julia, Giarratano Mariano****Loss of remnant biological corridors in the pampas environment due to changes in agricultural practices (Tandil, Buenos Aires, Argentina)**

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Poster session P08, Conservation planning

Native biota in the pampas is found in the areas less altered by man, roadside, rivers margins and fences verges, and pastures for cattle grazing playing the role of biological corridors. In Buenos Aires productive systems, characteristic for their high yields, evolved abandoning cattle raising to pursue permanent agriculturization. This would be the reason for the decrease in the availability of biological corridors. Wild fauna supports commercial hunting, based mainly on hare (*Lepus europaeus*), that is exported to Europe. The trends of cynegetic commercial production may be related with the ones of wild fauna populations and be used as an indirect assessment for them. The aim of this study was to know to what extent the changes in the agrarian techniques influence the availability of habitat for wildlife and if this is related to the trends of cynegetic production.

In Tandil County (Buenos Aires) we analyzed (1) the proportion of area in the county modified by agriculture was reported by qualified informants. (2) The changes in the use of the space determined by variations in production practices between 1992 and 2006 in a rural establishment were compared by analyzing satellite images and field georeferencing (GPS) of the edges. Results were mapped and the surfaces estimated (ENVI 4.1) (3) Official statistics of hare hunting yield in the province were analyzed comparatively with the data of the county reported from 110 interviews with qualified informants. Results show that: (1) 63% of the area is used for agriculture (2) Between 1992 and 2002 agroecosystems were drastically transformed intensifying the crop space: in 2002 the elimination of fencing subdivision of paddocks for handling cattle reduced a 0,17% the land for wildlife. The removal of cattle pastures reduced 17,25% more. (3) Hare production in Argentina decreased 50% in the last 15 years, like the province trend, probably because 73% of the exported hares are provided by Buenos Aires.

**Keywords:** Agroecology, wildlife, cynegetic activities, *Lepus europaeus*, technological changes

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**Climate change and vascular plant diversity**

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Poster session P12, Biodiversity and climate change

We made estimates of species number of vascular plants at the global scale for the three time slices 2020, 2050 and 2080. Our species – energy relationship for vascular plants were applied for assessment of future diversity status within the taxa. Species number of vascular plants can be predicted to a major extent by climatically determined latent heat for evaporation and geometrical structure of landscape, described as an altitudinal difference according to this species – energy relationship. Six climate scenarios (three for A2B SRES greenhouse gases emission projections, three for B2A greenhouse gases emission projections), produced by three different general circulation models were used in the study.

Results of calculations reveal, however, common features in potential alterations of global species diversity for vascular plants. So, potential number of species of vascular plants is significantly increasing in the Northern Hemisphere according to all three climate scenarios both in case of A2B and B2A SRES greenhouse gases emissions. The Southern Hemisphere is predicted to have loss of 5% to 20% species according to all six scenario variants. So, 5% - 50% vascular plant species can be lost at the area 10 -20 million square kilometres with Hadley Centre climate scenario at upper range, CSIRO scenario close to it and the CCC scenario at lower range. Alarming is also the timing of these negative changes. So, all six variants of calculations agreed that the largest negative changes (i.e. at area 30-40 million km<sup>2</sup>) are predicted to happen in year 2020 with further stabilisation to 20-30 million km<sup>2</sup> at the years 2050 and 2080. Global geographical pattern of climate driven species number of vascular plants is rather non-homogeneous and scenario dependent. Nevertheless, all twenty five global biodiversity hotspots mapped by Conservation International loose species in different time slices for the six climate scenario variants.

**Keywords:** climate change, species number of vascular plants, global, GCM, biodiversity hotspots

**Vodouhe Gbèlidji Fifanou**, Sinsin Brice, Coulibaly Ousmane

**Community perception of biodiversity conservation around Pendjari national park, Benin**

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Poster session P04, Managing biodiversity with a social-ecological system focus

The commitment of local communities to protected areas is essential for conserving biodiversity. As revealed in previous studies, people's perceptions of the park management and benefits that they obtain strongly influenced their perception about biodiversity conservation. In Benin, a range of models have been used in National Park management. In contrast with former strategies, the current management regime attempts to give local populations greater involvement and control. This study, carried out around the Pendjari National Park, investigated local people's views about ongoing park management activities, and assessed how different models influence their perception of biodiversity conservation. 164 local residents were surveyed using structured interviews in local languages. Stepwise Discriminant Analysis was used to analyze the data. The results indicate that the positive attitudes of local communities towards conservation of biodiversity are highly correlated with the current participatory management strategy, and with the respondents' educational level and ethnic origins. Respondents' perceptions of biodiversity conservation were significantly related to locally perceived benefits. Despite the fact that 89% of respondents are amenable to the concept of biodiversity management, the decision to ban agricultural activities on park land has increased negative opinions of the park management. Understanding local communities' perceptions of conservation and taking their concerns into account is essential in developing effective National Park management strategies.

**Keywords:** Benin, Biodiversity conservation, Pendjari National Park, Community perception, Resources use

**Wale Edilegnaw**

**Farmers' perceptions on replacement and loss of traditional crop varieties: examples from Ethiopia and implications**

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Poster session P04, Managing biodiversity with a social-ecological system focus

There is a wide spread concern that with adoption of more uniform improved crop varieties, there are chances of narrowing of crop varietal diversity on-farm due to possible replacement and loss. There are diversity of views on the question of replacement and loss in the literature. Despite their policy relevance, farmers' concerns and perceptions on the questions of replacement and loss have not been given explicit attention in genetic resources policy research. Farmers' perception is the key determinant of their actions and their actions, in turn, are the key determinants for their contribution in terms of on-farm conservation. Investigations on farmers' perceptions can inform decision makers and serve as a means of testing the policy relevance of scientific recommendations.

Based on these premises, this paper examines farmers' views on replacement and loss and its importance to their livelihoods. To that end, perception data were elicited from 395 farm households in Northern Ethiopia. The descriptive statistics show that, even though there is variation, the majority of the sampled farmers agree that the portfolio of varieties in the villages is ever changing, replacement and loss are happening and this trend is decreasing the chance to find traditional varieties on their fields. The logistic regression results further show that the important variables to explain farmers' perception and what the loss means to their livelihoods are farmers' networks, involvement in agricultural extension, chance in utilizing improved seeds, variety attribute preferences, market constraints, livestock ownership and frequency of food shortage that farmers face. Based on the empirical results, the paper concludes that future on-farm conservation strategies have to target farmers who better understand the occurrence of replacement and loss and those who better appreciate the role of traditional varieties to their livelihoods.

**Keywords:** Farmers' perception, loss, replacement, traditional varieties, Ethiopia

### **Weiss Erika Krisztina**

#### **Inventorying plant biodiversity in the Mediterranean**

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Poster session P17, Monitoring biodiversity

The geographical and human history of the Mediterranean basin, its flexibility in reacting to thousands of changes and its role as a natural laboratory makes it relevant in biodiversity research and conservation. The so called negative effects of human impact on the Mediterranean cause damages particularly along the coastlines and especially on the islands, which are much more vulnerable in this matter. Currently, at the Mediterranean Agronomic Institute of Chania, where I work, my personal tasks deal with the updating of a Mediterranean useful native plants' database, "MEDUSA", initiated in 1996, and the maintenance of the botanical garden of the institute which is supposed to be a Mediterranean plant conservation area. "Supposed", because the main species existing all over the garden is *Oxalis pes-caprae*, an invader from Cape-Province, South-Africa. One way of managing invasive species is the protection and preservation of native species and further more dealing with their possible uses. Although the MEDUSA database needs to be corrected, completed and updated, it can be considered a good start for further inventorying, being a vast work of several local coordinators, dealing mainly with present/ past ways of trading and uses of the Mediterranean plant species. During the first period of my work I have looked forward to find other information about Mediterranean biodiversity inventorying and I have found several publications, projects, etc. upon the subject. In the poster are shown the inventory and presentation of the works referring to Mediterranean biodiversity, which I have encountered so far. My further concern would be to settle connections between all these works and build up a mutual database, which would be a tool for restoration and protection of native biodiversity in the Mediterranean basin.

**Keywords:** Mediterranean, native plants, invasive species, biodiversity, database

### **Zhao Xueyong**

#### **Desertification and Biodiversity Conservation in Inner-Mongolia, China**

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Poster session P08, Conservation planning

Inner-Mongolia covers about 1.18 \*10<sup>6</sup> km<sup>2</sup> and stretches about 2400km from the east to the west, in which forest, grassland, gobi and desert ecosystems, dotted with 4166 lakes and wetlands and 107 rivers, distribute along this direction. There are about 2837 plant species, 604 vertebrate species, 81 fish species, 376 bird species, 118 animal species and 40,000 to 50,000 invertebrate species living in these ecosystems. However, desertification has been dramatically expanded in the past 50 years and the desert and desertified land in 2005 covers about 36% of the total area of Inner-Mongolia. As a consequence, about 50% of the above species is threatened by drying-up and/or salinisation of lakes and rivers, loss and fragmentation of habitats due to grassland desertification and deforestation and invasion of cropland into natural ecosystems.

Up to now, there are 99 species on the top of red list, including *Camelus ferus*, *Equus kiang*, *Equus caballus*, *Ovis montanus*, *Aquila chrysaetos*, *Gymnocarpus przewalskii*, *Tetraena mongolica*, and *Helianthemum soongoricum*.

Therefore, Inner-Mongolia is identified as one of the most important parts of China for desertification control and biodiversity conservation.

Up to 2006, Inner-Mongolia has established 190 nature reserves of a total area of 1.4\*10<sup>5</sup> km<sup>2</sup> for diversity conservation while measures, such as grazing exclusion from severely desertified grassland and restoration of rain-fed cropland into natural grassland and/or woodland, has been implemented with the aims to restore lost and fragmented habitats for endangered species.

**Keywords:** Inner-Mongolia, desertification, endangered species, habitat, diversity