ScenNet
Biodiversity and Ecosystem Scenarios Network

International Conference on Scenarios and Models of Biodiversity and Ecosystem Services in Support of Decision-making
24 – 26 August 2016, Montpellier, France

ABSTRACT BOOK

.

ScenNet

BELMONT FORUM

FRB FONDATION POUR LA RECHERCHE SUR LA BIODIVERSITÉ

Table of contents

Conceptual framework and first practical tests for a cumulative effects assessment with regard to the Marine Strategy Framework Directive

Silke Eilers *† [1,2], Thomas Raabe [3], Adorian Ardelean [4]

[1] AquaEcology – Marie Curie Str. 1 26129 Oldenburg, Germany
[2] Planktology, Institute for Chemistry and Biology of the Marine Environment, University of Oldenburg (ICBM) – ICBM Schleusenstraße 1 26382 Wilhelmshaven, Germany
[3] AquaEcology – Marie Curie Str. 1 26129 Oldenburg, Germany
[4] AquaEcology – Romania

Comprehensive assessments of the ecological status based on the integrative ecosystem approach need the integration of cumulative effects to provide a more realistic picture of actual impacts on the environment. Within a research project funded by the German Federal Environmental Agency, we developed a modular and flexible concept for cumulative effects assessment, which allowed the handling of different levels and qualities of information while maximising the integration of available information for the assessment.
The overall concept combines matrix models, individual based models and geographical analyses. The systematic organisation and integration of literature data for the different modules is facilitated by a literature database and analysis tool with various graphical and tabular outputs for the cumulative effects analyses.

First promising tests of the concept were conducted for blue mussels (*Mytilus edulis*) as well as for seagrass species (*Zostera spp*) with a selected number of pressures.
The concept can easily be adapted to other species groups or other types of pressures and addresses the holistic ecological view of the Marine Strategy Framework Directive. However, the huge number of theoretical possible cumulative effects and the complexity of their pathways and combined impacts are still big challenges and need further development.

Keywords: cumulative effects, Marine Strategy Framework Directive, seagrass, mussels, online tool, assessment, DEB model

*Speaker
†Corresponding author: silke.eilers@uni-oldenburg.de

Using land use change scenarios to inform the monitoring of species' conservation statuses

Stephanie Januchowski-Hartley * [1]

[1] Laboratoire Evolution et Diversité Biologique, UMR 5174 – Université Paul Sabatier – Bat. 4R1, 118 route de Narbonne, 31062 Toulouse cedex 4, France

Human land use change is a major threat to freshwater biodiversity worldwide. Considering land use change scenarios can contribute to and facilitate more proactive conservation and decision making. Drawing on three projections for 2051 we evaluated how land use could change within freshwater fish species ranges in the United States. Using an existing area based threshold, we identified both range-restricted and threatened species that are most likely to be impacted by land use change. We set our analyses within the context of species' status on the International Union for Conservation of Nature's Red List and United States' Endangered Species Act, and discuss the potential implications of our findings for informing species' conservation status assessments. We reflect on how these analyses could be further integrated with information on other human threats, such as dams, to further inform national and international assessments such as the Convention on Biological Diversity.

Keywords: freshwater, decision, making, land use change

*Speaker

From Scenarios over Models to Management — Alien Spread Management: A Case Study from the Western Cape, South Africa

Rainer Krug *† [1], Núria Roura-Pascual [1], David Richardson [1]

[1] Centre for Invasion Biology, Stellenbosch University (CIB) – Private Bag X1, Matieland 7602, South Africa, South Africa

In science and policy and its interface, simulation- and scenario-based approaches have been proven useful in understanding complex systems and their response to changing input parameters. For example, climate change models and scenarios developed by the ICPP yield reproducible and transparent results that have been used to guide policy development and implementation on the global and national scale.

Apart from these large scale applications, this approach is also of high value at the smaller regional scale (< 300.000ha). Here, policy (funding priorities and levels), conservation management (what and how much to spend where on conservation) and science (complex simulation- and scenario-based approach) can interact to guide the motivation for funding as well as the allocation of funds to removal of invasive alien plants.

The tool we present here uses

1. budget scenarios, i.e. amount of funding per area unit, and
2. management scenarios, i.e. prioritization strategies to prioritize areas for invasive alien plant clearing,

as input parameter for a spatially explicit simulation model (SpreadSim) to

1. predict the cover of major woody invasive alien plants (acacias, pines and hakeas) over time (30 years) at a regional scale (< 300.000ha) in the Fynbos biome (South Africa) and
2. to demonstrate and assess the impact of different management and budget scenarios on the area under alien cover

The model incorporates spatial and non-spatial scenarios and information, fire and invasive plant spread simulation as well as costs of clearing and budgets. It is a stochastic rule based simulation model build in R, using GRASS for spatial data storage and processing as well as C++.

Simulations were run over 30 years, during which one prioritization strategy was used, and the amount of area cleared per year was constrained by financial resources. By using different input scenarios, we demonstrated their impacts and interactions on the area under alien cover.

These simulations enable a transparent and reproducible motivation for appropriate funding,

*Speaker
†Corresponding author: Rainer@krugs.de

and at the same time provide a tool to develop and optimize management scenarios within a particular budget scenario to maximize the efficiency of IAP management. The SpreadSim model is designed in such a way that it can feed into other ecosystem service models, therefore allowing to quantify the impact of different management and budget scenarios on different ecosystem services (water yield, carbon sequestration, ...).

In this talk, I will give an overview over the whole study, including

1. the development of the scenarios, budget as well as management / prioritization
2. the model itself
3. some selected results
4. possible further steps to make this system available to conservation agencies and policy makers

Keywords: model, scenarios, budget, management, prioritization, optimization, invasive alien plants

Scenario-based modelling for management of Mediterranean forests: a review.

Alejandra Morán-Ordóñez *† [1], Kaori Otsu [2], Lluís Coll [3,4], François Lefevre [5], Lluís Brotons [1]

[1] Inforest Joint Research Unit (CSIC-CTFC-CREAF) – Spain
[2] CREAF — Ecological and Forestry Applications Research Centre (CREAF) – Spain
[3] Forest Sciences Research Centre of Catalonia (CTFC) – Spain
[4] University of Lleida (UDL) – Spain
[5] INRA, Ecologie des Forets Mediterraneennes (URFM) (INRA - URFM) – Institut National de la Recherche Agronomique - INRA (FRANCE) – France

The number of studies aimed at understanding the complexity of ecological patterns and processes and their interaction with human societies has dramatically increased in the last two decades, but especially since the publication of the Millennium Ecosystem Assessment reports in 2003 and 2005. Integrative models and scenarios are key tools to disentangle this complexity, forecast the ecological consequences of current and future states of societal development and support well-informed decision making. But, what's the state of the art in the development and application of these tools?
We are conducting a review of the methods and scenarios in use for evaluating the future of biodiversity and ecosystem services provision in the context of forest systems across the Mediterranean basin. The review is framed within the international ERA-net Foresterra INFORMED project (INtegrated research on FOrest Resilience and Management in the MEDiterranean) that seeks to foster forest system resilience through biodiversity management (from genes to communities). Mediterranean forests represent a good example of biodiversity-rich and complex ecological systems, with a long history of human perturbations and management and currently threatened by ongoing global change. With our review, we aim to know which types of models are more widely used (correlative vs process-based) and how widespread is the implementation of integrated modelling approaches – those accounting for feedbacks across sectors (e.g. agriculture and forestry) and spatial scales within a single modelling framework. We also evaluate the prevalence of the use of multi-driver scenarios – those accounting for the simultaneous impacts of multiple direct and indirect drivers (e.g. climatic, land use, management) – and single-driver scenarios in literature. The overall goal is to understand the state of the art in how indicators of the state of Mediterranean forests are being developed/modelled, and to identify priority areas for future research.

Preliminary results show that the number of studies that focus on a single biodiversity or ecosystem service indicator, use a single model or scenarios based on a single-driver outnumber the more integrative studies. Our study will directly inform the currently-in-progress regional European and Central Asia assessment of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) on integrated assessment modelling and scenarios.

*Speaker
†Corresponding author: alejandra.moran@ctfc.es

Keywords: Integrated Assessment Models, Mediterranean Forests, Modelling biodiversity and ecosystem services, Scenarios

Managing tradeoffs between food production, biodiversity, and ecosystem services: exploring win-no-loss scenarios with an evolutionary technique.

Francesco Accatino *† [1], Muriel Tichit [1]

[1] UMR SADAPT, INRA, AgroParisTech, Université Paris-Saclay – Institut National de la Recherche Agronomique - INRA – France

Models and optimization techniques are useful tools supporting the management of land for the provision of conflicting ecosystem services. Such tools meet the following difficulties. (i) Modelling the spatial heterogeneity of ecosystem services provision requires a high computational effort. (ii) Optimization techniques need to cope with many policy and physical constraints and with several management variables interacting in non-linear way. (iii) Different services are often not substitutable, thus optimization techniques must treat them separately without building aggregated indices. In this study we aim at proposing a methodological framework for supporting the design of win-no-loss scenarios, i.e., allocating land uses and land covers for maximizing the provision of a service, without causing losses in other services. We apply our methodological framework at the French scale. For addressing (i) we use Small Agricultural Regions (SARs) as spatial units. Those units are not too big, so the spatial heterogeneity is represented, and not too small, so to have a low computational demand. We build ecological production functions to estimate the provision of ecosystem services at the SAR level using management and geographical variables. The ecosystem services we consider are crop and livestock production, biodiversity, carbon sequestration and storage, pollination, timber production, and recreation. Management variables are the fraction of land covers in each SAR, and crop cultivation intensity (e.g., pesticide inputs). We design scenarios for assigning management variables to the different SARs and, in turn, we optimize one service at the French scale, imposing a constraint of no-loss on the others. For the optimization we use an evolutionary algorithm, which is able to address (ii) and, (iii). The evolutionary technique promotes land covers that deliver multiple services and softens the tradeoffs by allocating land covers delivering competing services in different SARs. We discuss the strength and weak points of the modelling framework and of the evolutionary technique for optimization.

Keywords: Scenarios, ecosystem services, tradeoffs, evolutionary techniques, Optimization techniques

*Speaker

†Corresponding author: francesco.accatino@versailles.inra.fr

Integrating the Social Value of the Benefits of Ecosystem Services into Sustainable Land Use Planning Process: Case Study in Nasugbu, Batangas, Philippines

Mary Jane Alvarez * [1], Osamu Saito [1], Kikuko Shoyama [1]

[1] United Nations University-Institute for Advanced Study of Sustainability (UNU-IAS) – 5–53–70 Jingumae, Shibuya-ku, Tokyo 150-8925 Japan, Japan

The sprawl of urbanization in rural areas posed both opportunities for growth, and threats in terms of trade-offs among different uses of land and other resources. Decision makers in these areas are faced with the difficulty of achieving multiple goals of increased production, raised living standards, food self-sufficiency, and resource conservation. Land use planning is a policy instrument used to achieve the balance between environmental and socioeconomic goals particularly of areas which depend highly on the environment and natural resources. A shift to a more participative process was demanded after outputs of traditional land use planning processes failed to achieve its intended outcome because of the failure to address the legitimate goals of land users. It is assumed that conflicts on land and resource use can be sort out by incorporating the community's values of the environment into decision making. However, social values and perception on the environment still has a very minimal influence on local land use patterns compared to a more quantified data of the environment's economic and ecological value. In developing countries, particularly the Philippines, the current thrust of the national government is to disperse urbanization and industrialization to spread employment opportunities in the countryside. Peripheral areas outside Metro Manila, including the municipality of Nasugbu, Batangas, has started to experience growth in terms of economic demands and use of its resources. The local government has started to update and revise its development plan with different development schemes being suggested. On the proposed research, preference-based value will be applied in quantifying residents' perceived value of the benefits derived from the ecosystem services. Primary data will be collected using a survey questionnaire with sections on respondents (i) socio economic characteristics, (ii) perceived value on the benefits derived from the environment, (iii) mark areas for each valued types of benefits, and (iv) perceived changes once land use change is implemented. Also, a database containing raster information to characterize the area's physical environment will be developed. It will make use of statistical models and GIS application to assess, map, and quantify the social values of the benefits. The study will generate Value Index quantifying how the Nasugbu residents perceived its environment and its spatial distribution. It will determine which demographic characteristics play significant factors in the way benefits of ecosystem services are being valued. Also, the relationship of the area's physical characteristics and the perceived value to its services will be assessed. Considering the municipality's economic and environmental goals, these quantitative and spatial analysis of the social values will be used to determine a development scheme which will provide sustainable outcomes to the municipality. The study is expected to show how social value of the environment can be assessed and quantified to be integrated and considered significantly during the land use planning process. It is expected that periodic assessment on this subject will provide knowledge

*Speaker

to decision makers for a well-informed policy and decision making.

Keywords: land use planning, GIS, social value, valuation, ecosystem services, benefits

Scenarios on the effects of environmental drivers and fishing in a Baltic Sea ecosystem

Barbara Bauer * [1], Valerio Bartolino [2], Mika Rahikainen [3], Jan Horbowy [4], Bärbel Müller-Karulis [1], Maciej Tomczak [1]

[1] Stockholm University – Sweden
[2] Swedish University of Agricultural Sciences – Sweden
[3] University of Helsinki – Finland
[4] National Marine Fisheries Research Institute – Poland

We describe a food web model of the Baltic Proper to understand how the fisheries and the abiotic environment in combination influence ecosystem structure and function. The model is constructed using recent ecological and fisheries data. It represents 21 functional groups, including the four most important commercial fish species in the open sea Baltic fisheries, and multiple fishing fleets categorized by vessel size and gear type. Alternative scenarios about nutrient load and climate change are modelled by a hydrodynamical-biogeochemical model, BALTSEM. The outputs of BALTSEM were used to drive abiotic environmental conditions and the production rate of phytoplankton in the food web model. The effects of these environmental scenarios on the food web were evaluated in parallel with a set of potential fisheries management strategies which were developed in a co-creation process with stakeholders. We use a set of indicators to compare the consequences of the various scenarios. These ranged from ecosystem structure indicators to indicators more directly focused on fish production as a provisioning ecosystem service. Indicators allowed comparison of the impacts of fisheries management choices on the ecosystem and to what extent those are modified by eutrophication and climate change.

Keywords: Ecopath with Ecosim, fisheries, eutrophication, simulation model, scenarios

*Speaker

Biomass allocation pattern in the temperate meadow steppe of Northern China

Feilong Hu *† [1]

[1] Nanjing Institute of Environmental Sciences, Ministry of Environmental Protection – China

Grasslands are one of the most widespread landscapes worldwide, covering approximately one-fifth of the world's land surface. Although China's grasslands cover only 6_˜8% of the world's total grassland area, they store 9%-16% of the total carbon in the world's grasslands. Many studies have focused on monitoring and understanding the factors affecting carbon partitioning; however, the role of species composition in carbon partitioning is still not fully understood. In this study, we evaluated the biomass distribution patterns and other indexes of vegetation in the meadow steppe of northern China, based on geographic information system (GIS) tools and field data for different community types. The results showed that the average biomass carbon density was 566.35 g C/m2 in the temperate meadow steppe. Among the different plant communities, *Sanguisorba officinalis* with 460.63 g C/m2 had the highest aboveground biomass (AGB), while a tessellated meadow had the highest belowground biomass (BGB). However, there were no significant differences in BGB among other types of plant communities (P0.05). The temperate meadow steppe contributed 111.20 Tg biomass carbon within an area of 12.90 × 106 hm2, where the AGB was 27.57 Tg and the BGB was 83.63 Tg. The root: shoot in the temperate meadow steppe was 3.03. There were two types of BGB distribution: the exponential function type, in which the BGB was mainly distributed at soil depths of 0-10 cm and 20-40 cm. The BGB distribution was the exponential function type in the *Filifolium sibiricum*, *Achnatherum splendens*, *Hordeum agriocrithon*, *Sanguisorba officinalis*, *Stipa Baicalensis*, *Carex tristachya*, and the tessellated meadow communities, indicating that this type of BGB distribution was a characteristic of grassland communities. The *Calamagrostis epigeios*, *Caragana microphylla* and *Phragmites australis* communities showed a BGB distribution that fitted the quadratic function, rather than the exponential function. Evaluation of grassland biomass carbon storage by different grassland communities is meaningful for understanding carbon storage dynamics. The results of this study provide a theoretical basis for developing management strategies and designing research on natural grasslands in northern China.

Keywords: meadow steppe, carbon density, biomass, communities

*Speaker

†Corresponding author: hfl@nies.org

Study of Community Management of Nature Reserves in the Mid-Subtropical Evergreen Broad-leaved Forest in China: A Case of Social Economy Investigation on the Communities of Jiangxi Tiger-Brain Nature Reserve

Qin Li *† [1]

[1] Institute of Biodiversity Science, Fudan University, Shanghai – China

Abstract: Establishment of nature reserves is the most effective way for biodiversity conservation. The conservation effect
of national nature reserve has a higher recognition in China, but the provincial nature reserve is still in the easiest uncared-
for. Especially in the Mid-subtropical humid forest zone in China, the unique topography and climate conditions makes the
region with a batch of important similar provincial and national nature reserves, for the protection of forest ecosystems and
wildlife with an essential role. This article chose Jiangxi Le-antiger-brain provincial nature reserve as the typical example,
the social and economic development characteristics of community and the conflict between conservation and development
have been studied. Based on the existing data, the characteristics of the mid-subtropical humid forest zone nature reserves
were analyzed. On this basis, some enlightenment and policy recommendations were put forward to the nature reserve
construction and community management in the mid-subtropical humid forest zone in China.

Keywords: Mid subtropical evergreen broad leaved forest, nature reserve, community management, regional economy

*Speaker
†Corresponding author: qinli12@fudan.edu.cn

Using biodiversity offsets to mitigate environmental damage

Isaac Peterson * [1], Sarah Bekessey [1], Ascelin Gordon [1]

[1] Royal Melbourne Institute of Technology (RMIT) – Australia

The use of biodiversity offsets to mitigate environmental damage is rapidly proliferating, with biodiversity offsets set to play a key role in nature conservation globally. While these policies are designed to compensate for development impacts on biodiversity, in many circumstances the environmental gains can take decades to accrue, or fall short of the "no-net-loss" (NNL) objective that underpins biodiversity offsetting. Previous work identifying the potential biodiversity outcomes under various offset schemes has focused on evaluating a particular development and associated offset implementation, rather than a systematic evaluation of how biodiversity offset policies perform in a spatial system with many development/offset exchanges taking place over time. Here we present a spatial model that can evaluate likely long-term biodiversity outcomes of biodiversity-offset policies at a range of scales.

We propose a spatial model that can be used to quantitatively estimate the performance of environmental policies including biodiversity offset policies at local through to landscape scales over decadal periods prior to their implementation. In the context of biodiversity offsets the model allows the estimated biodiversity gains and losses associated with development to be evaluated against a range of counterfactuals. The model can be used to forecast the outcomes of a specific policy and evaluate the potential for policy loopholes and systemic policy failure. In addition, the model can be used to determine the overall policy structures that are likely to meet desirable future targets with some degree of certainty, where specific future targets can be used as parameter constraints in the model. Together these approaches are complementary, with the ability to explore multiple policies and offset actions and assess the robustness of these options.

We explore the potential biodiversity outcomes resulting from a range of biodiversity offset policies in the context of a landscape with declining ecological value on three evaluation scales, namely the *local scale*, where the loss of biodiversity value from a particular development parcel is offset by an associated gain from one or more offset parcels, the *program scale*, composed of all cumulative set of land parcels involved all development and offsets in the scheme, and the *landscape scale*, comprising all parcels in the simulated landscape. We show that even under an idealized situation where the development-offset parcel-sets achieve NNL, the time lags involved in accruing offsets gains can lead to the policy failing it's NNL objective at the program and landscape scale when the offsets are implemented at the same time as or when lagging behind development. Conversely, we show that if the offsets are performed prior to development using an "offset banking" scheme, NNL is achievable using a number of the policies that fail when the offsets are implemented post development.

Keywords: offsets, conservation, modelling, No Net Loss

*Speaker

Exploring ecosystem services assessment and scenario modelling as tools to enhance protected area management and planning in Malampaya Sound Protected Landscape and Seascape (MSPLS), Northwestern Palawan, Philippines

Christmas De Guzman *† [1], Osamu Saito *

[2], Kaoru Ichikawa *

2

[1] United Nations University Institute for the Advanced Study of Sustainability (UNU-IAS) – United Nations University Institute for the Advanced Study of Sustainability 5–53–70 Jingumae, Shibuya-ku, Tokyo 150-8925, Japan
[2] United Nations University Institute for the Advanced Study of Sustainability (UNU-IAS) – United Nations University Institute for the Advanced Study of Sustainability 5–53–70 Jingumae, Shibuya-ku, Tokyo 150-8925, Japan

Areas that are important for biodiversity conservation or those of high conservation values provide significant benefits to people. They can be regarded as socio-ecological production landscapes and seascapes (SEPLS). These landscapes and seascapes are essential for human well-being as they provide various ecosystem services and in most cases, they are inherently resilient to external shocks and stresses having shaped and strengthened by long-term interactions between nature and people. The Philippines, considered one of the biodiversity hotspots in the world housing diverse types of ecosystems and species, faces biodiversity loss and habitat degradation due to climate change, land-use changes, and other anthropogenic factors. This can ultimately cause changes in the provision of ecosystem services and affect natural capital that many people depend on. Since 1990s, a number of protected areas has been established to safeguard areas that has biologically and ecologically unique features and characteristics, however, the need to transform protected area management system into a more holistic approach remains a challenge. Understanding how people interact with the environment and how different land-use based changes affect the delivery of ecosystem services are important aspects which will help provide better decision basis for protected area managers and policy-makers. This study focused on the Malampaya Sound Protected Landscape and Seascape (MSPLS) located in northwestern Palawan, southwest of the Philippines. MSPLS is a protected area (PA) characterized by diverse marine and terrestrial ecosystems and contains socioeconomically-important marine and forest resources. The sound or the marine zones – subdivided into (a) shallow brackish "inner sound" and (b) deep saltwater "outer sound" – play a critical role in the livelihood and well-being of the adjacent local communities. In the preliminary research activities conducted at the

*Speaker
†Corresponding author: cbdeguzman@gmail.com

inner sound (Site 1), we used the Toolkit for the Indicators of Resilience in SEPLS developed by UNU-IAS and the International Partnership for Satoyama Initiative to identify elements of socio-ecological resilience that are strongly interrelated and we conducted participatory ecosystem services assessment and mapping to understand how changes in ecosystem services influence human well-being. Thirty respondents, representing two villages from the inner sound, participated in a participatory assessment workshop that employed focused group discussions and resilience scoring through guided questionnaires. Among the five elements of socio-ecological resilience, both villages showed high resilience in biodiversity interrelating knowledge and innovation, but low resilience in landscape/seascape diversity and ecosystem protection interrelating livelihoods and well-being. In addition, both obtain a wide range of benefits from MSPLS which they identified into: provisioning services, regulating services and cultural services. Validation and analysis of data collected is ongoing, as well as looking into possible correlation among ecosystem services and changes in the landscape/seascape. The study aims to implement the same field methodology at the outer sound (Site 2) to have a baseline assessment of ecosystem services in MSPLS and to draw insights into developing a participatory scenario. Furthermore, the second phase of this study includes modelling land-use based scenarios to identify trade-offs among key ecosystem services and find synergies between biodiversity conservation and other facets of human well-being.

Keywords: Keywords: Biodiversity and Ecosystem Services, Participatory Ecosystem Services Assessment, Socio ecological Resilience, Protected Area Management and Planning, Land use based Scenarios

Using the Biodiversity Intactness Index to evaluate biofuel production scenarios in the Eastern Cape, South Africa: towards better assessment of the impact of biofuel production on biodiversity

Ryan Blanchard *† [1,2], Patrick O'farrell [1], David Richardson [2]

[1] Council for Scientific and Industrial Research (CSIR) – South Africa
[2] Centre of Excellence for Invasion Biology (CIB) – South Africa

Biofuels have been identified as a priority issue in South Africa – to reduce the country's reliance on imported fossils fuel, and for catalysing social development. Many potential plant species (feedstocks) and a variety of spatial locations could be used for this purpose. This paper considers the potential biodiversity impacts of several scenarios for biofuel production in South Africa, focussing primarily on quantifying the impacts to biodiversity. The biodiversity intactness index (BII) was tested as a means to evaluate scenarios to quantify potential impacts. The indicator is an estimation of the average population size of a wide range of organisms under different land-use systems relative to their baseline populations. Land-use change scenarios were based on potential for conversion of available and suitable land. Impacts of potential feedstocks were categorised based their species traits. Results indicate that potential biodiversity losses can range between 0.5 - 25% as compared to current levels across the different scenarios developed depending on the land-use and species options chosen. Using the BII for analysing the difference in scenarios provides a useful step to better understanding the overall impacts on biodiversity. This research demonstrates that the traits of the species, features of the recipient environment, and the extent of plantings relative to areas with high conservation value must all be considered. We also highlight some key aspects of how scenarios and models can assist planners and managers in relation to biofuels, using the South African situation as a test case.

Keywords: biofuels, energy, biodiversity, tradeoffs, protected areas, land use

*Speaker
†Corresponding author: rblanchard@csir.co.za

A participatory modeling framework for assessing biodiversity and ecosystem services future scenarios

Claudia Capitani * [1], Neil Burgess [2], Isaac Malugu [3], Kusaga Mukama [3], Boniface Mbilinyi [4], Pantaleo Munishi [5], Phil Platts [6], Lisen Runsten [7], Robert Marchant [1]

[1] Environment Department [York] – University of York Heslington York YO10 5DD United Kingdom, United Kingdom
[2] UNEP-WCMC (UNEP-WCMC) – 219 Huntington Road, Cambridge, UK, United Kingdom
[3] WWF Tanzania Forest Service – Tanzania
[4] Sokoine University of Agrivulture (SUA) – Tanzania
[5] Sokoine University of Agriculture (SUA) – Tanzania
[6] Department of Biology [York] – University of York PO Box 373 York YO10 5PW, United Kingdom
[7] UNEP-WCMC – 219 Huntington Road, Cambridge, UK, United Kingdom

In highly diverse and rapidly changing tropical regions, future persistence of biodiversity and ecosystem services (ES) will largely depend on societal willingness to undertake the changes needed to reduce land use and land cover changes (LULCC) and climate change impacts. In particular, through policies that maximize efficiency and opportunities to meet win-win expectations for sustainable development. We developed a framework to build participatory spatially-explicit scenarios of LULCC that captures and harmonise perspectives and knowledge across a diverse range of stakeholders and regions, and can inform decision makers on potential impacts of land and climate policies on biodiversity, ES and livelihood. We applied the framework at different spatial and temporal scales in East Africa.
In the Tanzania mainland we assessed alternative development strategies to the year 2025 - under either a business as usual (BAU) or a green development (GE) scenario. Under a BAU scenario, with no productivity gain and an increasing population, cultivated land expands by ca. 2% per year (up to 88,808 km2), with large impacts on woodlands and wetlands. Despite legal protection, encroachment of natural forest occurs along reserve borders. Additional wood demand leads to degradation (i.e. loss of tree cover and biomass) up to 80,426 km2 of wooded land. This leads to a net carbon stock loss of -290,348,518.4 Mg. The alternative GE scenario envisages decreasing degradation and deforestation with increasing productivity and implementation of REDD+ and Payment for Ecosystem Service schemes. Under this scenario, assuming a 10% increase in crop productivity, cropland expands by 44,132 km2, and additional degradation is limited to 35,778 km2. Carbon stock losses due to deforestation and degradation is reduced by 49% and biomass increase is expected in reserved areas and agro-forestry landscapes.

Under BAU, biodiversity hotspots in montane ecosystems are affected by communities' responses to land scarcity and high demand for fuel wood. Vertebrate total biodiversity is lost by 7% and endemic vertebrate species are heavily impacted (more than 50% habitat loss for 21 species). WIth variable climatic conditions, if crop suitability increased on the montane slopes compared to lowlands, then further encroachment of montane forest could occur. In the GE scenario, this impact is reversed through legal protection enforcement and reduced pressure on reserved forests

*Speaker

supported by PES and improved agricultural systems.
Anticipating future conservation and land use interaction under developing strategies and climate change may contribute to set spatial priorities for intervention sites. Applying a bottom up approach enhances success chance by building local actors ownership and awareness, by incorporating local knowledge and by reducing the gap between local communities and policy makers.

Keywords: REDD+, sustainable development, climate change, conservation

Getting to know Mexico's biodiversity through a modelling perspective: modelling initiatives and the development of indicators for decision making

Melanie Kolb * [1], Octavio Pérez-Maqueo [2], Patricia Koleff [3], Tania Urquiza [3], Jesus Alarcon [3], Veronica Aguilar [3], Miguel Equihua [2], Julian Equihua [3], Pedro Diaz Maeda [3], Nashieli García Alaniz [3], Mariana Munguia [3], Fernando Pardo Urrutia [3], Everardo Robredo Esquivelzeta [3], Michael Schmidt [3]

[1] Institute of Geography (IGg, UNAM) – Mexico
[2] Institute of Ecology (INECOL) – Mexico
[3] National Commission for the Knowledge and Use of Biodiversity (CONABIO) – Mexico

In order to make informed decisions about biodiversity, its use and conservation, it is necessary to count with a solid knowledge base about the distribution and abundance of species and ecosystems. Mexico is one of the five most biodiverse countries, forms part of the Mesoamerican hotspot with high levels of diversity, endemics and threats and many important knowledge gaps persist for Mexican biodiversity. Even though information on land use and cover is readily available, data on species distributions, conservation status and functional processes associated with ecosystem services are scarce. Nevertheless, conceptual developments and progress in informatics have led to a series of initiatives in Mexico to model different aspects of biodiversity on a national scale and to analyze changes over time as part of a communication strategy to feed the science-policy interface. In the context of systematic conservation planning, a set of 2950 potential species distribution models (PSDM) based on climate data was generated for all vertebrate groups, covering 80-95% of all species per group. Then human impacts on biodiversity were modelled, so as to include hotspots of endemic and threatened species in the selection of priority sites for terrestrial, marine and fresh water conservation. Given the usefulness and data availability for indicators of human impact on biodiversity, MEXBIO, a model based on the GLOBIO methodology was developed and a time series ranging from 1995 to 2010 was produced. This way an analysis of change was possible, including the impacts of land use, degradation of natural vegetation and LUCC, road infrastructure and resulting fragmentation. The average impact of human activities increased from 42 in 1995 to 46 in 2010 on a 0-100 scale, where 100 means complete transformation. This indicator is also being used in regional prospective models that use scenarios of LUCC to explore possible political options for conservation and development. In the last few years, the challenge of obtaining recent and robust data on biodiversity has entered a new phase, centered on the development of an ecological integrity indicator that integrates data on the composition, structure and function of ecosystems, as well as on degradation caused by human impacts in close collaboration with several government and academic institutions. In this context, a National Biodiversity Monitoring System is being established to fill in situ data gaps, as well as a remotely sensed data base on detailed land cover and changes in extension and productivity. Another focus has been the development of data bases on functional traits of

*Speaker

fauna, so that PSDM can be modified using explicit effects established for each species and the degradation factors encountered inside their range. The priority sites were used for Mexico's gap analysis requested by the protected area agency and used to fulfill commitments to the CBD. MEXBIO has been part of the country reports to CBD to inform about the status of biodiversity. Besides the PSDM and MEXBIO have been used for a wide range of other policy informing activities of CONABIO (national and regional).

Keywords: Biodiversity modelling, Mexico, MEXBIO, systematic conservation planning, priority sites, ecological integrity, scenarios, species distribution models

Population dynamics and the management of the Indian national fish, Indian mackerel (Rastrelliger kanagurta) from the Arabian Sea

Jitendra Kumar *† [1], S Benakappa *

[1], Gangadhara Gowda *

[1], Harsha Nayak *

1

[1] Karnataka Veterinary, Animal and Fisheries Sciences University – College of Fisheries, Mangalore – 575 002, India, India

The knowledge in fish biology and population dynamics of a species is necessary for the rational exploitation. Indian Mackerel, *R. kanagurta* is a very important pelagic fishery resource along the West coast of India. The present investigation was based on the observation of a total of 3165 *R. kanagurta* individuals ranging in size from 9 to 29 cm total length (TL). Fortnightly samples were collected from Mangalore fish landing centre from September 2014 to March 2016 formed the study material. Electronic Length Frequency Analysis (ELEFAN-I) was used to estimate the population parameters. The growth parameters L∞, K were estimated 29.4 cm and 1.2/yr respectively. The growth performance index (ϕ) was found to be 3.01. The length of fish in commercial catches in Mangalore coast (South-west coast of India) ranged from 9 cm to 29 cm of total length. The smaller sized fish (9-19 cm) represented nearly 27.9 per cent. 72.1 per cent of fish were contributed by the size range 19-29 cm. The estimated values of total, natural and fishing mortality rates of *R. kanagurta* were 3.89/yr, 1.96/yr and 1.93/yr. respectively. As the exploitation ratio (E) was 0.5 and the fishing mortality was moreover equal to the natural mortality [F=Z-M (3.88-1.96)=1.93/yr]. Therefore, the mackerel fishery along Mangalore coast was exploited to the optimum level. Variation in M can be explained as a natural phenomenon which is controlled by density dependent (predation, availability of food etc.) as well as density independent factors (disease, natural calamities etc.) and varies within same species in different location. One major recruitment peak per year was observed in *R. kanagurta* in the study area. Exploitation level of *R. kanagurta* was slightly equal to the optimum level of exploitation. Equal fishing mortality of *R. kanagurta* verses the natural mortality observed from the present study indicated the balance position in the stock. This information would be very useful to prevent the decline of fish populations and for its sustainable fishery management along Mangalore coast, Karnataka.

*Speaker

†Corresponding author: jitenderanduat@gmail.com

Keywords: Population Dynamics, Mackerel, Fishery Management, Karnataka coast

Application of Bayesian belief networks to marine ecosystem services assessment to support management

Olivia Langmead * [1]

[1] Marine Institute Plymouth University – Marine Institute Plymouth University Drake Circus Plymouth Devon PL4 8AA, United Kingdom

Ecosystem services are becoming increasing important in informing decisions in natural resource management, planning and biodiversity conservation. However, applications for their consideration in the management of UK coastal and marine systems are not well developed. In this study a Bayesian belief network (BBN) modelling framework linked with a geospatial database was applied to local scale case studies to incorporate spatial information on: 1) seabed habitats; 2) the intensity of human activities giving rise to pressures on the seabed; and 3) the existing configuration of spatial management (marine protected areas plus any sectoral measures such as fisheries restrictions, harbour authority regulations). These data were processed into gridded layers that were used for model input. Information on the relationship between pressures, subtidal sediments and their capacity to provide ecosystem services was used to construct conditional probability tables to underpin causal relationships within the socio-ecological models. Linkages in the models that represented 1) the impact of human activities on seabed habitats were conditioned using detailed information on the likely sensitivity seabed habitats groups to specific pressures; and 2) the potential seabed habitats to provide ecosystem services were conditioned using matrices that link ecosystem services to marine features. Model output comprised two types of information: the potential for the seabed to deliver ecosystem services based solely on the particular habitat type (i.e. in a pristine world without human activities) and the likely actual provision of services which took into account the impact of human activities and their pressures on the seabed and any likely impairment in ecosystem service provision. This information was used to construct maps to show the likely potential and actual provision of different ecosystem services across the marine landscape. This method allowed visualisation of the spatial configuration of provision of ecosystem services of different types, and enabled identification of areas with high service provision within the context of human activities and management. Such information is important because it can ensure that management measures or interventions, such as Marine Protected Areas, target important areas for ecosystem service provision, and that trade-offs between activities and management interventions that may affect marine ecosystem service provision are made explicit and considered by decision makers. This BBN framework approach is a novel way to combine many types of information, together with their underlying uncertainties, and combined with a geospatial database, enabled mapping of ecosystem services across a landscape, which can be readily communicated with managers and stakeholders.

Keywords: Marine, Bayesian belief network

*Speaker

Modelling the impact of forest management operations on forest ecosystem services in Latvian state forests

Zane Libiete *† [1], Arta Bardule [1], Martins Lukins [1], Ilze Puspure [1]

[1] Latvian State Forest Research Institute "Silava" (LSFRI Silava) – Latvia

Interest in the world's natural forests ecosystems has grown to unprecedented heights, not only with growing awareness of their role in the climate change mitigation but also with awareness of importance to human well-being. Following the growing interest in mapping and evaluation of ecosystem services both on European level and internationally, several initiatives have been launched also in Latvia during recent years, the first of these dealing with meadows and coastal ecosystems. The most widely represented terrestrial ecosystems in Latvia, however, are the forests. With 54% forest cover, Latvia is the 4th most forested country in Europe. Consequently, in Latvia, the forestry sector plays a key role in the management of the natural environment and the provision of ecosystem service values. One half of all forests belongs to the state and are managed by Joint Stock Company "Latvian State Forests". To analyse the impact of different forest management operations (felling, drainage system maintenance, and forest road construction) on forest ecosystem services like provision of timber and non-wood forest products, clean water, carbon sequestration, soil quality and others, a 5-year collaboration project between the JSC "Latvian State Forests" and Latvian State Forest Research Institute "Silava" was started in 2016. A model catchment (size 2004 ha) in commercial forests was chosen for the study of impacts, and 1876 ha large catchment in protected area was chosen to serve as unmanaged area for comparison. Felling in the model area is planned in 2018 but forest road construction and drainage network maintenance works are already started. Following activities are carried out in the project: 1) analysis of land use in the model areas; 2) analysis of importance of different forest ecosystem services for different stakeholder groups; 3) mapping of ecosystem services in the model areas; 2) ground water, surface water as well as soil sampling and chemical analyses; 4) vegetation survey; 5) survey of structures important for biodiversity; 6) analysis and modelling of impacts of forest management on ecosystem service provision. Ecosystem classification according to CICES (Common International Classification of Ecosystem Services, 2016) is used in the study.

Keywords: Forest ecosystem services, forest management, catchment, modelling, CICES

*Speaker

†Corresponding author: zane.libiete@silava.lv

Which model structure to assess alternative management of bottom trawl fisheries in the Gulf of Lions?

Marianela Pataccini *† [1], Sandrine Vaz‡ [1], Stéphanie Mahévas [2], Sigrid Lehuta [2]

[1] Laboratoire Halieutique Mediterranee (LHM) – Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER) – France
[2] Ecologie et Modèles pour l'Halieutique (EMH) – Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER) – Nantes, France

The bottom trawl fisheries of the Gulf of Lions mostly target hake but are largely multi-specific. There is no set catch limit, few species are assessed (hake, red mullet, sardine and anchovy) and several are submitted to minimum landing size (MLS) regulation. However a large part of catches is composed of individuals below MLS that are consequently discarded with bottom trawlers being responsible for the bulk of discards.
The new Common Fisheries Policy (CFP) now includes a landing obligation of all regulated species and fishermen are expected to dispose of catches that are bellow legal size as these cannot be commercialized for human consumption purpose. In parallel, a management plan of fishery effort in the Mediterranean Sea was set and aims to bring the Hake stock toward the Maximum Sustainable Yield between 2015 and 2020. In this increasingly constraining context, these fisheries should avoid discards as much as possible. In collaboration with fishers, two scientific projects are starting to investigate which strategies may allow to reach these objectives as well as insuring fishery viability in the long run. Spatial dynamic fisheries models allow addressing these questions by integrating all the available information on the species biology and the fishery behaviour, in particular the discarding behaviour, and simulating the outcomes of alternative fishery strategies. The modelling framework ISIS-Fish (Integration of Spatial Information for Simulation of FISHeries) is a flexible tool developed to simulate fishery dynamics and was chosen as the decision-support tool. ISIS-Fish allows for the analysis of the interactions between all system components (including economic features) and provides an integrated way to simulate management scenarios accounting for fisher reactions.
In the present study we describe the analyses conducted in order to devise an appropriate system structuration taking into account spatial and temporal fleet, fish population and management dynamics. The challenge is to develop a model that suits management expectations while making best use of available information and coping with uncertainties. We describe the analyses that drove the choices made for spatial scales, species to include and fleets to describe.

Keywords: Fishery management, ISIS, FISH model, Gulf of Lions fisheries, landing obligation.

*Speaker
†Corresponding author: marianela.pataccini.alvarez@ifremer.fr
‡Corresponding author: Sandrine.Vaz@ifremer.fr

Integrating local and indigenous knowledge to model Grauer's gorilla protection in the community forests of eastern Democratic Republic of Congo

Ngobobo -As- Ibungu Urbain * [1]

[1] NGOBOBO -As- Ibungu Urbain (DFGFI) – 18, Boulevard Kanyamuhanga, Goma, Nord Kivu,, Congo - Kinshasa

Grauer's gorillas are among the world's most endangered primates. Past research on Grauer's gorillas has focused on a high-altitude population from Kahuzi-Biega National Park. Yet, most Grauer's gorillas live in the low altitude primary forests of the east of the Congo basin, including in the community forests and National parks, where terrain, climate and food availability greatly differ from montane forests. We hired local and indigenious people to study gorilla presence, abundacy, distribution and continuously tracked a single Grauer's gorilla group ranging at an altitude of 600m between Maiko and Kahuzi-Biega National Park for over 3 years. Along the group's trail, we systematically collected GPS data every 50m, identified food remains and counted nest sites. During the study period, the group's home range had a diameter of around 10 km and nest sites included 20 nests on average. The group's daily travel distance typically ranged between 500m and 2,000m. However, the gorillas only used a small portion of the available habitat. They preferred travelling along valleys and avoided hilltops. The analysis of multispectral satellite imagery revealed that the vegetation in these valleys is different, with a more open canopy than the hilltops. The vegetation undergrowth of the valleys is denser, providing the gorillas with the Zingiberacea, Marantaceae and Commelinaceae plants they consumed. Understanding habitat requirements of low altitude Grauer's gorillas will help conservationists model a conservation strategy in eastern Congo that are susceptible to host large Grauer's gorilla populations and will help focus conservation efforts.

Keywords: local community, indigenious knowledge, grauer's gorilla, ranging patterns, community forest

*Speaker

Applying the Biodiversity Intactness Index to a marine ecosystem: the southern Benguela

Kate Watermeyer * [1,2], Lynne Shannon [2], Guy Midgley [1]

[1] Université de Stellenbosch (SUN) – Victoria Street, Stellenbosch, 7600 Stellenbosch, Cap occidental, South Africa
[2] Marine Research Institute, University of Cape Town (Ma-Re, UCT) – Private Bag X3 Rondebosch 7701, South Africa

Biodiversity is known to be an important factor in the resilience of systems to perturbations in environmental or other drivers, buffering the system against the effects of large-scale change. Human induced pressures on ecosystems such as exploitation, habitat destruction, pollution and indirect forcing via climate change are driving high rates of biodiversity loss. Reducing biodiversity loss is thus a common goal in management plans and a means of measuring biodiversity change is therefore necessary. Scholes & Biggs (2010) proposed the biodiversity intactness index (BII) as a simple but sensitive indicator of biodiversity loss since pre-modern or baseline levels. The index has been successfully applied to a terrestrial environment in southern Africa. Here the application of the BII in a marine environment, the southern Benguela, is explored. The BII was calculated both from data and expert opinion and its ability to assess biodiversity change due to fishing pressure assessed.

Keywords: Biodiversity index, marine, ecosystem change

*Speaker

Spatial Modelling and Scenario Analysis to Monitor Aboveground Forest Biomass in Cambodia Using High Resolution SAR Data

Ram Avtar * [1], Osamu Saito [1], Ridhika Aggarwal [1], Rajesh Thapa [2]

[1] United Nations University Institute for the Advanced study of Sustainability (UNU-IAS) – Jingumae Shibuya-ku, Tokyo, Japan
[2] Japan Aerospace Exploration Agency (JAXA) – Japan

Forest cover change is an important factor in global environmental change because of rapid deforestation in tropical areas. Deforestation activities are driven by both anthropogenic activities and natural phenomena that adversely impacts biodiversity and ecosystem services. In 2008, United Nations Reducing Emissions from Deforestation and forest Degradation (REDD+) programme were launched to curb deforestation and forest degradation in tropical countries. Recent COP-21 Paris agreement highlighted "encouragement for Parties to implement existing frameworks for REDD+ mechanism". For effective implementation of REDD+ mechanism, a robust cost effective Measurement, Reporting and Verification (MRV) system should be developed. Geospatial data has been a key for the implementation of REDD+ MRV system. Launch of L-band Synthetic Aperture Radar (SAR) sensor by Japan Aerospace Exploration Agency (JAXA) has opened a wide opportunities in forestry sector to accurately monitor various biophysical parameters of tropical forest such as forest cover, deforestation, forest biomass etc. without limitations of clouds. This study is focused on monitoring of forest cover and forest biomass in Cambodia from 2007 – 2015 using PALSAR (Phased Array L-band Synthetic Aperture Radar) data. Furthermore, spatial modeling techniques have been used to visualize and quantify the future variation in forest cover and forest biomass. Future trends of biomass and forest cover depends on past processes of deforestation and represents a consolidation of relationships between time, space, and various driving factors. Logically developed spatial model has been used to extrapolate the likelihoods of various forest spatial patterns into the future scenario. These models are useful to offer a means to examine future change in the forest scenarios with the implementation of various policies and can be used to predict the usefulness of various policies at national to regional level. Moreover, this will allow appropriate measures to control deforestation at different time scale. Monitoring and future projection of variation in forest cover and biomass in Cambodia has been done while considering different forest policy frameworks. Spatial modeling tools have been used to model present scenario and future scenario considering Business as Usual (BAU), changes in concession land, community forestry and protected areas. Based on the BAU scenario, the current aboveground biomass could decrease significantly. Other scenarios such as concession land, community forestry and conservation suggest less risk of decrease in forest biomass.

Keywords: PALSAR, Aboveground forest biomass, REDD+

*Speaker

Aquaculture and its future under climate change: a new approach to impacts, adaptation and vulnerability research

Muhammed A. Oyinlola *† [1], Gabriel Reygondeau [1], William W.l. Cheung [1]

[1] Nereus Program, Institute for the Oceans and Fisheries-The University of British Columbia (NF-NP) – 2202 Main Mall — Vancouver, BC-V6T1Z4, Canada

Aquaculture is growing rapidly over the last three decades at an average rate of about 8.8% per year in 2012, making it the fastest growing agro-food sector in the world. In 2012, aquaculture produced about 66.6 million tonnes (42%) of the total fish food production. However, the sustainability of mariculture (marine and brackish aquaculture) is uncertain because of the impacts of climate change and ocean acidification on the cultured species and supply of fish feed and oil. However, these risks to seafood production from mariculture may be adapted through possible adjustment of aquaculture technology and practices. This study aims to develop models and scenarios to assess the impacts, adaptation and vulnerability of aquaculture to global environmental change. Using habitat suitability modelling, climate change effects on the availability of suitable environment required for culturing marine organisms are projected. In addition, aquaculture development is driven by social and economic factors, with consumer demand and preferences driving prices, costs and technology that affect aquaculture productivity and viability. Given the large uncertainties of future changes in these socio-economic factors, we develop a set of shared socio-economic pathways for aquaculture (SSPA) to assess its sustainability under climate change. These SSPAs are developed using participatory approach that incorporates knowledge from regional and domain-specific experts. The approach developed in this study will help understand the risk of climate change for mariculture, the potential of adapting to these risks and the costs and benefits associated with different risk-reduction pathways.

Keywords: Aquaculture, Climate change, Sustainability aquaculture, Scenarios, models

*Speaker

†Corresponding author: m.oyinlola@oceans.ubc.ca

Modelling land use scenarios and consequences on watershed services at the Thadee watershed, Thailand

Yongyut Trisurat * [1]

[1] Faculty of Forestry, Kasetsart University – Bangkok, Thailand

The Thadee watershed, covering 112 km2, is the main source of water agriculture and household consumption in the Nakhon Srithammarat, Thailand. Natural forests in the watershed have been degraded and transformed to fruit tree and rubber plantations. These activities have resulted in landslide and flooding. This research predicts how furtherland-use/land-cover changes during2009–2020 and changes in rainfall scenarios may influence water yield and sediment load in the Thadee River. Local stakeholders defined t three different land use scenarios, namely trend, development and conservation. Spatially explicit empirical models were used to allocate future land demands and to assess the contributions of separated and combined effects of land use and rain fall changes. On both ecosystem services. A large expansion of rubber plantations in the uppersub-watersheds under the development land use scenario. A reduction of the current annual rainfall by 30% would decrease the predicted water yields by 38% from 2009. In constrast, an increase of 36% with respect to current rainfall would amplification of 50% of the current runoff. In addition, very high sediment load and runoff levels were predicted combination of development and use and extreme rain fall scenarios. Three conservation activities-protection, reforestation and a mixed-croppingsystem-are proposed and optimized distributed in the watershed landscape according to the allocated budget in order to have the greatest impact on watershed services of the Thadee watershed.

Keywords: Thadee watershed, scenarios, models, watershed services

*Speaker

The fate of tropical forests associated to the demographic explosion in Africa.

Ghislain Vieilledent * [1,2], Frédéric Achard [3], Stephen Peedell [3], William Laurance [2,4]

[1] CIRAD, UPR BSEF – Centre de coopération internationale en recherche agronomique pour le développement [CIRAD] : UPR105 – Campus International de Baillarguet 34 398 Montpellier cedex 5, France
[2] European Commission, Joint Research Center (JRC) – Via Enrico Fermi, 2749, 21027 Ispra VA, Italy
[3] European Commission, Joint Research Centre (JRC) – Via Enrico Fermi, 2749, 21027 Ispra VA, Italy
[4] James Cook University (JCU) – Centre for Tropical Environmental and Sustainability Science and College of Marine and Environmental Sciences, James Cook University, Cairns, Queensland, Australia, Australia

1. A large proportion of Africa's population relies on forests for livelihood. In the context of Africa's demographic explosion, what would be the fate of tropical forests on this continent at the end of the 21st century?

2. Using three different deforestation data-sets (from FAO Forest Resources Assessment, Global Forest Watch and JRC TREES project), we modelled tropical deforestation accounting for population growth in Africa. We used data at the national level for all African countries.

3. Fitting a linear mixed model (R2 $>$ 90% for log-transformed variables), we showed that the absolute deforestation (in ha) increased significantly with the area of remaining intact forest (in ha) and the population size (in number of people). We also estimated a historical mean absolute deforestation (in ha) per country, independent of the forest and population sizes.

4. Using our model and the United Nations population projections until 2100, we forecasted the likely evolution of the forest cover for each African country following a "business-as-usual" scenario.

5. Our results show that most African countries should experience a decrease of the deforestation speed after 2050 due to the demographic transition and a reduction in arable land availability. Despite this dynamics, we show that many countries with high biodiversity (such as Madagascar, Mozambique, Uganda and Tanzania) are likely to lose more than 50% of their forest during the 21st century, with different percentages of residual intact forest per country at the end of the century. Gabon, Cameroon and Central African Republic are the only countries that should experience a moderate decrease of their forest cover ($<$ 25%).

6. Conclusion: Such projections are alarming for local populations, biodiversity conservation and climate-change. To avoid this scenario, policy makers and stakeholders should take rapid decisions to effectively curb deforestation in African tropical countries.

*Speaker

Keywords: Africa, biodiversity, demogaphic growth, tropical deforestation, scenarios

Highlighting global management priorities for deep-sea diversity

Skipton Woolley * [1], Derek Tittensor [2], Heini Kujala [1], Piers Dunstan [3], Timothy O'hara [4], Brendan Wintle [1]

[1] University of Melbourne – Australia
[2] Department of Mathematics and Statistics [Canada] – Dalhousie University — Halifax, Nova Scotia, Canada B3H 3J5 — +1 (902) 494-2572, Canada
[3] CSIRO Wealth from Oceans Flagship (CSIRO) – CSIRO, Wealth from Oceans Flagship, Hobart, TAS, Australia, 7000., Australia
[4] Museum Victoria – Marine Invertebrates,Museum Victoria GPO Box 666 Melbourne Vic 3001 Australia, Australia

Deep-sea benthic environments are one of the largest ecosystems on earth. They harbour huge diversity, yet no detailed plans exist to effectively undertake direct conservation management within this immense realm. We urgently need to consider priority regions for conservation in the face of increased anthropogenic activity and exploration into deep-sea environments. A fifteen-year effort in assembling databases on brittle-star and squat-lobster biodiversity in the deep-ocean has allowed us for the first time to examine the global distribution of abyssal biodiversity. It shows a pattern remarkably different from any other already discovered, whether on land or in the shallow oceans. But what are the conservation implications? Are deep-sea biodiversity hotspots adequately covered by existing marine protected areas? Are there areas of congruent shallow-water and deep-sea biodiversity? Here we present analyses to address these questions, provide a resource to assist with efforts to protect biodiversity, and reflect on the implications for large-scale conservation planning in the deep ocean. With the ongoing work to develop a legally-binding instrument on the conservation of biodiversity in areas beyond national jurisdiction, the incorporation of deep-sea benthic ecosystems into the discussion is critical.

Keywords: Biodiversity, Prioritisation, Deepsea

*Speaker

Surface modelling of biodiversity and ecosystem services

Tianxiang Yue * [1]

[1] Institute of Geographical Sciences and Natural Resources Research (IGSNRR) – China

A surface of an ecosystem service or a driving force of ecosystem changes is uniquely defined by both extrinsic invariants and intrinsic invariants. Ground observation is a source of the intrinsic invariants. Satellite observation is an important source of extrinsic invariants. Ground observations are able to accurately estimate ecosystem services and driving forces of ecosystem changes at sample plots, but these sample plots are too sparse to support the spatial simulation of changes of ecosystem services with required accuracy. Satellite remote-sensing can supply spatially continuous information about the surface of ecosystem services, which is impossible from ground-based investigations, but their descriptions incorporate considerable uncertainty. This oral presentation is to present the progress in the method for high accuracy surface modelling (HASM) as well as its applications to simulating biodiversity and ecosystem services as well as driving forces of their changes. The applications include spatial interpolation, downscaling, upscaling, data fusion, and data assimilation.

Keywords: Surface modelling, biodiversity, ecosystem services, HASM, Ground observation, Satellite observation

*Speaker

Assessing the impacts of land use change on China's biodiversity

Cao Mingchang *† [1], Haigen Xu [1], Juncheng Lei [1], Yi Wu [1]

[1] Nanjing Institute of Environmental Sciences, Ministry of Environmental Protection – China

Land use change is the main direct driver causing biodiversity loss worldwide. China is one of the 12 mega-biodiversity countries in the world. China also one of the countries that experienced the most rapid land use change globally due to the huge social and economic development in nearly 30 years. The accelerated land use change brings threats to China's biodiversity and increase pressures on species and ecosystem. In this study, the coupling GLOBIO3 and CLUE model was used to identify the impacts of land use changes on current and future China's biodiversity. The mean abundance of original species relative to their abundance in undisturbed ecosystems (MSA) was used as the indicator for biodiversity change. Besides, four land use scenarios, which were baseline scenario (1990-2000 trends), baseline scenario (2000-2008 trends), policy scenario, conservation scenario, were further developed to projection of China's future biodiversity change in 2050. Our results showed that the China's MSA value currently had significant spatial variation and presented different trend under four scenarios. Some suggestions were put forward to reduce the land use change on China's biodiversity.

Keywords: Land use change, Biodiversity, MSA vulue, China

*Speaker

†Corresponding author: caomingc@163.com

Integration of climate and land use scenarios in ecosystem service assessment

Sathaporn Monprapussorn * [1]

[1] Department of Geography, Faculty of Social Sciences, Srinakharinwirot University – Thailand

Provisioning of services to human and environment is one of the crucial roles of ecosystem. Ecosystem gives a variety of services such as providing for food, habitat, recreation and conservation options. The capacity of delivering essential ecosystem services to social well-being is impeded by climate and land use change, causing a significant change in quality of functions and services of many ecosystems.
A focus on how to estimate future ecosystem services by integration of climate and land use change scenarios would be fruitful for collaborative planning and decision support system. FIntegration framework is being applied to coastal ecosystem in Thailand. The 2050 climate scenario is projected by using WorldClim at 30 seconds resolution. Projection of land use change scenario in 2050 using land allocation model is simulated by framing of three scenarios; economic, business as usual and sustainability driven. Preliminary result reveals that increase in sea level rise, temperature and extreme weather events, while decrease in mangrove forest area and increase in urban expansion will impact function and service of coastal ecosystem and community resilience. There is thus an urgent need on scaling up plan and policy related to integration of climate and land use change to sustain ecosystem services.

Keywords: Climate, Land use, Ecosystem service, Coastal

*Speaker

Downscaling simulations of future climate in Poyang lake basin of China

Zhao Na * [1], Yue Tian-Xiang [1]

[1] Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences – China

In this research, a comparison between Coupled Model Inter-comparison Project Phase 5 (CMIP5) data and observations at 83 meteorological stations in Jiangxi province was carried out and a statistical downscaling scheme with a combination of regression method and high accuracy surface modelling method (HASM) was used to downscale the mean annual temperature(MAT) and mean annual precipitation (MAP). For MAT, ordinary least squares (OLS) linear equation that used latitude and elevation as explanatory variables was employed to give the spatial trend, and HASM was used to interpolate the residual. The method produced the MAT is abbreviated as HASM-OLS. For MAP, geographical weighted method (GWR) using latitude, longitude, elevation and impact coefficient of aspect as independent variables was applied to produce the spatial distribution, and HASM was used to modify the residual. This method is abbreviated as HASM-GB. The spatial downscaling from 1o to 1km grids for period 1976-2005 and future scenarios were achieved by using the mentioned downscaling methods. The prediction accuracy was assessed at validation site from Jiangxi province, with mean absolute error (MAE) and mean relative error (MRE). Results indicate that MAT was underestimated about 1.16oC while MAP was underestimated about 191.48mm in general in the whole land of Jiangxi province. The CMIP5 output exhibits large uncertainty. MAE of MAT was reduced by 72.90% and MRE of MAT was reduced by 72.91% after using downscaling method. Meanwhile, MAE and MRE of MAP were reduced by 51.52%, 51.54% respectively. In terms of downscaled scenarios of RCP2.6, RCP4.5 and RCP8.5, from T1(1975-2006) to T2(2011-2040),the whole land of Jiangxi would become drier under all the scenarios. And the MAE exhibits rising except in RCP 2.6. The study area would become wetter and warmer under all RCPs routines from T2 to T3(2041-2070) and T3 to T4(2071-2100), except in RCP2.6 scenario from T2 to T3.

Keywords: Downscaling method, Future climate, HASM, Temperature, Precipitation, Poyang lake, China

*Speaker

Biodiversity scenarios neglect future land use changes

Nicolas Titeux *† [2,1], Klaus Henle [3], Jean-Baptiste Mihoub [3,4], Adrián Regos [1,2], Ilse Geijzendorffer [6,5], Wolfgang Cramer [5], Peter Verburg [7], Lluís Brotons [1,2,8]

[2] Centre de Recerca Ecològica i Aplicacions Forestals (CREAF) – 08193 Cerdanyola del Vallés, Spain
[1] Forest Sciences Centre of Catalonia (CTFC) – Ctra. Sant Llorenç de Morunys km 2 25280 Solsona, Spain
[3] UFZ - Helmholtz Centre for Environmental Research – Permoserstr. 15, 04318 Leipzig, Germany
[4] Université Pierre et Marie Curie – UMR 7204 MNHN-CNRS-UPMC – France
[6] Institut de recherche de la Tour du Valat – Institut de recherche de la Tour du Valat – Le Sambuc, 13200 Arles, France
[5] Institut méditerranéen de biodiversité et d'écologie marine et continentale (IMBE) – INEE, Université d'Avignon et des Pays de Vaucluse, Institut de recherche pour le développement [IRD] : UMR237, Aix Marseille Université, CNRS : UMR7263, INSB, INSU – Aix Marseille Université, Campus Etoile, Faculté St-Jérôme case 421 Av. . escadrille Normandie-Niemen 13397 MARSEILLE CEDEX 20, France
[7] VU University Amsterdam – De Boelelaan 1087 1081 HV Amsterdam, Netherlands
[8] Consejo Superior de Investigaciones Científicas (CSIC) – 08193 Cerdanyola del Vallés, Spain

Forward-looking approaches exploring possible futures for biodiversity allow decision makers to weigh the impacts of different policy options and strategies. Although biodiversity is affected by multiple threats, most scenarios addressing the effects of future environmental changes on biodiversity focus on a single threat only. We examined the studies published during the last 25 years that developed biodiversity scenarios based on climate and land use change projections. Results show that more than 85% of them used climate change projections alone, indicating that biodiversity scenarios focus overwhelmingly on the future impacts of climate change and largely neglect future changes in land use. This imbalance in the research agenda has increased over time and has now reached a maximum.
We raise concern that too strong a focus on climate change could dilute research efforts that examine the effects of other threats to biodiversity which are just as important, if not more so. The destruction and degradation of habitats through land use changes are among the most significant and immediate threats to biodiversity. They may act in concert with climate change to push ecological systems beyond tipping points. Therefore, the neglect of other factors than climate is not a credible approach and may lead to potentially dangerous conclusions regarding the relative importance of different threats to biodiversity and ecosystem services in the future.

We advocate strengthening interdisciplinary research efforts at the crossroads between ecological and environmental sciences to face the challenge of developing interoperable simulations of future environmental changes that embrace multiple pressures. The most pressing need is to define a widely endorsed strategy to generate and integrate future simulations for a range of environmental pressures operating across varying scales. Although climate is mostly constrained by large-scale forces related to economic globalization, other responses to these same forces – such as land use changes – are largely determined by local factors. The main challenge will be to connect global and local approaches to simulate future environmental changes that reflect the

*Speaker
†Corresponding author: nicolas.titeux@ctfc.es

interactions between global dynamics and the diversity of local contexts.
We also show that the agreement on a common framework on climate change observations and simulations, the availability and accessibility of such data and the release of special reports on emission scenarios that are interpretable by a broad interdisciplinary audience boosted the interest of the scientific community to deal with climate change. We highlight how the work of the IPCC has had a knock-on effect on the ecological science community during the last decades. An IPCC-like mechanism is therefore needed to take up the challenge of developing a multifaceted approach to anticipate the future of biodiversity. We urge the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES) to formally identify the development of scenarios that embrace the impacts of multiple interacting pressures on biodiversity as a key priority for the international research agenda. We believe that this intergovernmental body should play an authoritative role in stimulating and structuring the collaborative research efforts that will be needed to address this important challenge.

Keywords: Biodiversity projections, climate change, ecological forecasting, land cover change, land system science, predictive models, species distribution models, storylines

Use of community-based theatre for validating and disseminating scientific research findings and interventions: a pilot study from semi-arid Ghana.

Yaw Boafo *† [1], Osamu Saito * ‡ [2], Kazuhiko Takeuchi [3]

[1] Integrated Research System for Sustainability Science, The University of Tokyo (IR3S) – 7-3-1 Hongo, Bunkyo-ku, Tokyo, 113-8654,, Japan
[2] United Nations University Institute for the Advanced Study of Sustainability (UNU-IAS) – 5-53-70 Jingumae, Shibuya, Tokyo150-8925, Japan
[3] United Nations University (UNU) – Japan

In a conscious effort to avoid the typically top-down flow of knowledge and information from research activities, *the Climate and Ecosystem Change Adaptation and Resilience Research in Semi-Arid Africa: An Integrated Approach (CECAR-Africa)* has been using participatory and community-based strategies to build awareness and engage diverse stakeholders throughout the research process since its inception. By using participatory actions, CECAR Africa aimed at offering appropriate platform for discussing, reflecting on, and creating and communicating future climatic uncertainties and scenarios, as well as co-producing adaptation and intervention strategies under current drivers. This study reports on a pilot study of the use of community-based theatre in the dissemination and validation of scientific research findings by highlighting the processes, procedures and outcomes as well as lessons learnt. The study focal area is purposively selected village communities in semi-arid Ghana, a socio-ecological landscape noted for high sensitivity and susceptibility to climate and ecosystem changes and prevalent poverty.The pilot study found out that community theatre worked effectively as a dissemination tool allowing households and communities to use fictitious characters to depict their exposure, sensitivity and adaptive capacity to climate and ecosystem change stresses such as drought, floods, bushfires, provisioning ecosystem services degradation and decline based on past, present and future scenarios. Generally, the audience interviewed were receptive to the drama. Most interviewees especially women stated that the drama piece has helped them find a voice to contribute to communal discussions. Some also indicated that it through the fun, they had learnt about environmental problems occurring as a result of their actions and inactions and indicated on the need for evaluation leading to a change their behaviour towards the use and management of their natural ecosystem. Ongoing action involves an evaluation of the methods, techniques and processes as a first step towards identifying limitations before upscaling the activity to other communities.

Keywords: Theatre, climate and ecosystem changes, semi, arid Ghana, poverty

*Speaker
†Corresponding author: yboafo@gmail.com
‡Corresponding author: saito@unu.edu

Offsetting the effects of mining in Central Africa : could social compensation be the key ?

Helene Dessard [1], Juliette Chamagne * [1], Solène Happert [1], Fabien Quétier [2], Annabelle Morcrette [2], Pauwel De Wachter [3], Laurène Feintrenie [1], Claude Garcia [1]

[1] Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD) – Centre de coopération internationale en recherche agronomique pour le développement [CIRAD] – 42, rue Scheffer 75116 Paris, France
[2] BIOTOPE – Biotope – France
[3] WWF (WWF) – Gabon

The Tri-National Dja - Odzala - Minkebe Forest landscape (TRIDOM) covers 178000 km^2 across the borders of Cameroon, Gabon and the Republic of Congo. Almost 97% is covered by sparsely populated lowland tropical rainforest and is globally important for the conservation of large mammals (elephants, gorillas, chimpanzees). The TRIDOM is destined to be an emerging iron ore province with several deposits currently being explored and two mining projects ready for exploitation. One potential mechanism for mitigating these pressures is biodiversity offsetting, which is a voluntary initiative on behalf of the economic operators. A developer contemplating a project that will destroy a habitat will design, fund and implement conservation actions elsewhere to compensate for that loss.
Conservationists highlight that the infrastructure being built related to mining (railroads, roads, powerline) will have direct and indirect impacts on the ecosystems, especially as they will enable the influx of migrants, who will need land for their cultivation, and increase the pressure on wildlife and other forest resources. Furthermore, these roads establish the front door to the poachers. The combined impacts of fragmentation and increased hunting pressure could transform the large intact forest landscape into a mosaic of isolated and thus vulnerable protected areas, no longer fit to conserve its mega-fauna or maintain large scale ecosystem processes. Possible mitigation options such as anti-poaching patrols, support for alternatives like agroforestry,projects of breeding and fish farming differ in their effectiveness and applicability, in the TRIDOM as anywhere else. Actually, it depends on the context, on the willingness of the operators and their financial means.

To better understand the impacts, constraints and limitations of these options, we used participatory modelling techniques to build a model of the socio-ecological system of the TRIDOM. We transformed this model into a role playing game that was played with different sets of local stakeholders (miners, foresters, NGOs, ministries...) in order to explore future scenarios for the TRIDOM, in terms of infrastructure development and of biodiversity outcomes. Key conclusions from the analysis are that (1) managing these impacts requires a strategic and multi-sectorial landscape-level approach, rather than dealing with each separate project sequentially, but (2) the combination of fragile states and high biodiversity makes compliance to international standards of ecological offsets almost impossible, and as a result, most experts consider that (3) financing social compensation could at least mitigate the indirect effects linked to mining devel-

*Speaker

opment. There is a clear push to move from "like for like" compensation schemes to "making it acceptable" packages. The real challenge for traders is to reconcile local development with conservation of forests and their biodiversity.

These conclusions are widely applicable and relevant in a context of expanding infrastructure investments in this region.

Keywords: Ecological offsets, forested socio, ecological system, Central africa, companion modeling

A tale of two villages: Coupling social and ecological drivers to explore alternative futures for the forests of the Congo Basin.

Claude Garcia *† [1,2], Eglantine Fauvelle [3], Micresse Kamto [4], Lucas Schnapper [5], Laurene Feintrenie [1,6,7], Hélène Dessard [8]

[1] CIRAD UR Forêts et Sociétés – CIRAD : UPRForêts et Sociétés – France
[2] Forest Management and Development (ForDev - ETH) – Switzerland
[3] CIRAD UMR System – CIRAD – France
[4] Université de Dschang – Cameroon
[5] AgroParistech – AgroParisTech – France
[6] CGIAR Research Program on Forests, Trees and Agroforestry – Kenya
[7] CATIE, Turrialba – Costa Rica
[8] CIRAD UR Forêts et Sociétés (CIRAD UR Forêts et Sociétés) – CIRAD : UPRForetset Sociétés – TA C-105 / D. Campus international de Baillarguet. 34398 Montpellier Cedex 5 - France, France

Until recently, the pressure on the forests of the Congo Basin and their biodiversity was comparatively low. But this is changing with the combined and interacting effects of global warming and land-use change linked to mining, forestry or the development of large-scale plantations. Exploring the possible futures of these forests and their biodiversity requires an understanding of the web of interlinked causal factors, where ecological processes and social drivers enter in complex and non-linear interactions across multiple scales. This knowledge can be used to develop models which weight external drivers of change - public policies, market changes, global warming - against endogenous processes shaping the system - forest and wildlife population dynamics, households' aspirations, cultural rules and norms.

The gordian knot of these models is the process by which a stakeholder decides to act. Two critical factors to consider and include are (1) the bounded rationality of stakeholders at every scale, taking decisions with incomplete or even faulty information, under situations of high uncertainty, and (2) their behavioural plasticity or the capacity to adapt their strategies to changing environmental and social conditions. These are defining elements of a social and ecological system, and ones that are notoriously difficult to represent with classical dynamic models.

To overcome this difficulty, as part of the CoForTips research project, we have been developing over the last three years a role-playing game: AgriForEst (Agriculture and Forest in Eastern Cameroon). This game and the model it embodies were developed through a participatory approach – the Companion Modelling (ComMod) approach- with men and women from both bantu and baka pygmies ethnic groups from four different villages in Eastern Cameroon. In AgriForEst, players represent households in a archetypical roadside village in the middle of the forest. They allocate labour force to different activities -hunting, gathering or cultivating - which impact the land cover of the board and generate resources. While the forest dynamic, wildlife reproduction and agronomic sub-components are based on actual research results, none of the rules regarding governance, land tenure nor conflict resolution are defined in the model. This gives complete

*Speaker
†Corresponding author: claude.garcia@cirad.fr

freedom to the players to either mimic existing arrangements and institutions or invent new ones.

The game was used to explore (1) the response of local communities to a scenario of infrastructure development and (2) the complementarity and competition between food and cash crops (cocoa) in the later phases of the forest transition. The game sessions raised issues of governance, market access, power asymmetries between bantu and baka pygmies, between migrant and locals , and soil fertility maintenance and restoration. AgriForEst sheds light on the underlying process that underpin collective action in a typical forest village of the Congo Basin where local communities progressively move from hunting/gathering and shifting cultivation to more market integrated livelihood strategies.
Developed jointly with stakeholders, decision makers and academics across disciplines, such models serve as boundary objects, highlighting the forces driving change and the pitfalls and bottlenecks that must be overcome to avoid negative impacts of external interventions.

Keywords: Participatory Modelling, Cameroun, Forest Transition, Role Playing Game, Transdisciplinarity, CoForTips, ComMod

Future socio-ecological systems and human well-being in Japan: questionnaire surveys for participatory scenarios

Chiho Kamiyama * [1], Osamu Saito [1]

[1] United Nations University (UNU-IAS) – 5-53-70 Jingumae, Shibuya 150-8925, JAPAN, Japan

Scenario planning is increasingly recognized as useful tool for exploring plausible future paths of the human society. Strengthening local context is regarded as an important aspect for capturing the socio-ecological dynamics of biodiversity and ecosystem services, and recently more attention has fallen on participatory tools and processes that can bridge the information on drivers and the knowledge systems in scenario building processes. To understand general trends and people's perceptions of possible drivers that might impact on the biodiversity, social-ecological systems and human well-being, we conducted questionnaire surveys in Japan, targeting both general public and experts from universities, research institutes, the government, business sectors, and NGOs/NPOs throughout Japan.
From web questionnaire survey of the public (n=3,093) and experts (n=101), we found that both the public and experts tended to perceive natural disasters (especially earthquake/tsunami, flood/typhoon, and intensification of natural disasters under climate change) and the issues in population and cities (population outflow from rural area/marginalized community, aging society with fewer children, and regional disparities in development) as more likely drivers that affect social and ecosystem changes by 2050. On the other hand, compared with the public, the experts tended to perceive changes in economy/resources, policy/governance, life style/value system/perspective on nature (especially diversification/globalization and loss of traditional knowledge), technological innovation, and regional conflicts/religious conflicts/war, may occur with higher uncertainty, but the impact will be considerably higher if they actually change significantly by 2050.

To understand the linkage between ecosystem services and human-wellbeing, we conducted questionnaire surveys of public (high school students and their families) in urban area (Tokyo; n=591) and rural area (Noto Peninsula, Ishikawa prefecture; n=418) about their preference of the services. We found that, generally, people preferred nature-oriented services than techno-oriented services (e.g. feeling sacredness in real nature vs. feeling sacredness from video, photos or virtual nature). However, people in urban area tended to prefer more techno-oriented services than nature-oriented services, compared with people in rural area. These results indicate the importance of developing bottom-up, diverse and multi-special scale scenarios to engage with the diversity of local context.
In conclusion, we discuss key factors on the Japan's future society that were identified in our questionnaire surveys, and provide basis for formulating potential future scenarios in Japan, indicating the need for raising public awareness and developing capacity to promote the participatory processes.

*Speaker

Keywords: Ecosystem services, biodiversity, future society, drivers, value system, stakeholders

Scenario planning for managing biological invasions in the Cape Floristic Region

Núria Roura-Pascual *† [1,2], Rainer Krug [1], David Richardson [3], R. Arthur Chapman [4], Tanja Hichert [5]

[1] Centre for Invasion Biology, Stellenbosch University (CIB) – Private Bag X1, Matieland 7602, South Africa
[2] Universitat de Girona (UdG) – Departament de Ciències Ambientals, Facultat de Ciències, Universitat de Girona, Campus Montilivi, 17071 Girona, Catalonia, Spain
[3] Centre for Invasion Biology, Stellenbosch University (CIB) – Private Bag X1, Matieland 7602, South Africa, South Africa
[4] OneWorld Sustainable Investments – PO Box 8359, Roggebaai 8012, South Africa
[5] Institute for Futures Research, Stellenbosch University – P.O. Box 2010, Bellville 7535, South Africa

Invasive species alter the functioning of natural ecosystems, creating "novel ecosystems" comprising species occurring in combinations with no analogues within a given biome. Management of these ecosystems is characterized by high levels of uncertainty. There are no tried and tested methods for dealing with these new environmental conditions, and every management intervention is an experiment. Multiple factors that drive invasion and which interact in complex ways demand innovative management approaches.
We show the utility of scenario planning in considering options for management at a regional scale ($<$ 300.000ha) in an area with substantial problems with invasive alien plants: South Africa's Cape Floristic Region. We adopted the approach outlined by Wilkenson (1995) for developing the scenarios. The procedure was facilitated by an expert on strategic conversation to avoid particular points of view from dominating discussion. The approach enabled us to identify the driving forces that shape the present status and the options for management of major woody invasive plants, and to construct a set of scenarios grounded on those drivers that have the greatest impact and the highest degree of uncertainty (i.e. those that we have the least knowledge about).

Attitudes of landowners and management capacity appeared as the crucial uncertainties influencing the spread of major invasive species, and were thus used as the axes of the scenario matrix in which to build the future scenarios on the management of biological invasions. Plotting current management units (i.e. area defined at a regional scale subject to a clearing project) into the scenario space highlighted key differences among areas and facilitated the identification of their probable future outcomes. These insights can assist in directing particular management units towards more desirable futures.

Our study highlights the need to link social, political and legal constraints with ecological processes to assure the effectiveness of management operations in controlling biological invasions.
Wilkenson L (1995) How to build scenarios. Planning for "long fuse, big bang" problems in an era of uncertainty. Wired (Special Edition, Scenarios: The Future of the Future):74-81

*Speaker
†Corresponding author: nrourapascual@gmail.com

Keywords: driving forces, future, management, invasive alien plants, South Africa, uncertainty.

Estimating movement potential with individual-based models to estimate conservation action efficiency

Sarah Bauduin *† [1], Eliot Mcintire [2], Martin-Hugues St-Laurent [3], Steve Cumming [1]

[1] Université Laval, Faculté de foresterie, de géographie et de géomatique – Pavillon Abitibi-Price, 2405 rue de la Terrasse, Québec, QC, G1V 0A6, Canada
[2] Pacific Forestry Centre, Natural Resources Canada – 506 Burnside Road West, Victoria, BC, V8Z 1M5, Canada
[3] Université du Québec à Rimouski, Département de biologie, chimie et géographie, Center for Northern Studies, Center for Forest Research – 300 allée des Ursulines, Rimouski, QC, G5L 3A1, Canada

Human land use and climate change can disrupt movement of terrestrial animals and therefore degrade movement potential of a population over a landscape. Quantifying and mapping movement potential can support management decision-making by identifying and locating movement barriers. Once identified, resulting negative impacts may be addressed. Tools are needed to forecast movement potential to evaluate the efficiency of conservation measures. In this study, we used a spatially explicit individual-based model previously developed for the southernmost caribou population in Quebec (Canada) to test the impact of climate change and road restoration actions on the caribou movement potential. We built several scenarios for future landscapes by combining climate change scenarios with different levels of road restoration. We predicted caribou movement on these landscapes and evaluated the effect of climate change and road restoration on caribou movement potential. Climate change impacts reduced caribou movement potential and only a complete removal of all secondary roads inside the protected areas was able to fully compensate for climate change impacts. Spatially explicit individual-based models coupled with landscape scenarios that derive movement potential can be an effective management tool to anticipate movement patterns for endangered species. They are useful to predict climate change impacts and evaluate the potential efficiency of conservation measures.

Keywords: Atlantic Gaspésie caribou, fragmentation, landscape restoration, movement model, protected area, road, spatially explicit individual, based model

*Speaker
†Corresponding author: sarahbauduin@hotmail.fr

Pattern vs process: comparing estimates of land-use impacts from the PREDICTS and Madingley models of biodiversity

Samantha Hill * [1,2], Mike Harfoot [2], Tim Newbold [3], Georgina Mace [3], Andy Purvis [1]

[1] Natural History Museum (NHM) – Cromwell Road London SW75BD, United Kingdom
[2] UNEP World Conservation Monitoring Centre (UNEP WCMC) – 219 Huntingdon Road, Cambridge, CB3 0DL, United Kingdom
[3] University College London - London's Global University (UCL) – Gower Street - London, WC1E 6BT, United Kingdom

The PREDICTS project (www.predicts.org.uk) has collated biodiversity data from scientists worldwide in order to produce a global database of terrestrial species' responses to land use and related human pressures. The database has been successfully used to model anthropogenic impacts to local biodiversity on a global scale and its outputs are now being integrated into global and regional policy. The Madingley General Ecosystem model (www.madingleymodel.org) is a mechanistic model used to evaluate how anthropogenic pressures influence whole ecosystems. Between them, these models can make predictions about a wide range of facets of natural capital, from species-richness to biomass production. It is therefore important to assess whether results from the PREDICTS and Madingley models agree when they are used to answer the same question. Good agreement would help to produce a unified message to policy makers and increase confidence in both models; even disagreement may provide valuable clues as to the strengths and weaknesses of the models. Unlike PREDICTS, the Madingley model does not model communities of known taxonomic identification, but cohorts based around sets of functional traits. Therefore we used both models to estimate human impacts on the abundance of groups of individuals with specific functional traits. Anthropogenic pressure was quantified in both models using Human Appropriation of Net Primary Production. We examine how the model results compare for different trophic levels (omnivore, carnivore, and herbivore), body mass sizes and thermoregulatory groups. We discuss how these results strengthen the models, how they may inform model intercomparisons more generally, and how they may provide novel insights into the links between biodiversity loss and impacts to ecosystem services.

Keywords: biodiversity, functional traits, model intercomparison, anthropogenic impacts

*Speaker

Modelling community changes due to nutrient addition in a global network of grassland experiments

Dorothee Hodapp * [1], Alexey Ryabov [1], Stan Harpole [2], Elizabeth Borer [3], Eric Lind [3], Helmut Hillebrand [1], Nutrient Network [4]

[1] ICBM, Carl-von-Ossietzky University Oldenburg – Germany
[2] German Centre for Integrative Biodiversity Research (iDiv),Helmholtz Centre for Environmental Research – UFZ – Germany
[3] Department of Ecology, Evolution, and Behavior, University of Minnesota – United States
[4] several institutions across the globe – United States

Species diversity is undergoing considerable changes in part due to anthropogenic influences such as habitat fragmentation and fertilization. The impact of nutrient addition on plant community composition and its consequences on the provision of ecosystem services has been extensively studied in experimental setups and theoretical frameworks, but generalisations across experiments and natural communities remain challenging. Here we present a spatially explicit resource competition model which allows the independent manipulation of species number and traits (resource requirements), resource distribution and dispersal across a meta-community landscape. It computes the effects of species composition changes on mechanisms driving biodiversity-ecosystem functioning relationships. Since the model structure is almost identical to the setup of a global network of grassland diversity experiments (Nutrient Network), including 30 sites across the globe with data of at least 4 years after nutrient addition we are able to present the comparison of model predictions with actual changes in community composition and productivity due to addition of one or more nutrient(s).

Keywords: biodiversity, ecosystem functioning, meta, community model, nutrient addition, community composition, resource competition, Nutrient Network (NutNet)

*Speaker

Integrating ecological models to secure the future of biodiversity across flammable continents

Luke Kelly *† [1,2], Lluís Brotons [3], Michael Mccarthy [2,4], Assu Gil-Tena [3]

[1] University of Melbourne (UoM) – School of BioSciences University of Melbourne, Australia
[2] ARC Centre of Excellence for Environmental Decisions (CEED) – Australia
[3] Forest Sciences Centre of Catalonia (CTFC) – Ctra. Sant Llorenç de Morunys km 2 25280 Solsona, Spain
[4] University of Melbourne (UoM) – Australia

Fire is a natural process that shapes ecosystems worldwide. However, the frequency of fires has been modified by climate and landscape change, and inappropriate fire regimes threaten biodiversity in Australia and the Mediterranean Basin. There is an urgent need to predict the responses of biodiversity to future fires. Recent advances in understanding of fire regimes have contributed much to the knowledge and management of Mediterranean Europe and south-eastern Australian ecosystems, but substantial challenges remain in managing fire for biodiversity conservation. These include a limited understanding of species responses to the spatial and temporal arrangement of fires, a lack of effective approaches for setting conservation objectives when species have differing responses to fire, and inadequate methods for evaluating alternative fire management strategies when dealing with uncertainties such as unplanned fires. Here, we present a framework for predicting the impact of future fire regimes on biodiversity which directly address these problems. This includes linking a suite of spatially explicit models and tools based on extensive field data, fire regime simulations and formal decision theory. Our framework has four main steps that we showcase using plant and animal data from south-eastern Australia ('malllee' vegetation; 104,000 km2) and Catalonia (north-eastern Spain; 32100 km2). First, we develop statistical models of species' responses to fire history. Second, we use biodiversity indices to represent how the relative abundance of multiple species is influenced by fire. Third, we use fire simulations to predict how biodiversity will change under different scenarios of prescribed burning and wildfire. Finally, we show how conservation targets based on biodiversity indices can be incorporated into a decision-making framework for fire management. In the south-eastern Australian case study, we found that older vegetation was disproportionately important for the conservation of birds, reptiles, and small mammals in flammable landscapes. In this example, applying formal decision theory showed that the optimal fire management strategy over much of the state space was to fight wildfires. Our approach will enable land managers to link spatial fire data with distributional knowledge of plant and animal species to answer questions as diverse as "what will the immediate effects on biodiversity be if a 10,000 ha wildfire occurs in a National Park?" and "how much and where should planned burning be done to maximise biodiversity in flammable landscapes?". We discuss the challenges faced by scientists and decision makers when implementing fire management for conservation and provide guidance on linking a suite of spatially explicit models and tools. South-eastern Australia and Catalonia share some similarities by virtue of having Mediterranean-type climate and vegetation. But there are important differences between the two regions – including the history of land use, human population size,

*Speaker
†Corresponding author: ltkelly@unimelb.edu.au

and the size of fires. We hope that considering these differences will help to make our approach more globally transferable.

Keywords: fire, species distribution models, biodiversity index, conservation, fire simulation, birds, reptiles, small mammals, decision theory

Incorporating ecological processes into biodiversity models alters the projected effectiveness of alternative management response options

Karel Mokany * [1]

[1] CSIRO – Australia

Biodiversity outcomes under global change will be influenced by a range of ecological processes, and these processes are increasingly being considered in models of biodiversity change. Accounting for these processes could influence our understanding of which management responses to global change pressures are likely to be most effective, though the importance of these effects remains unclear. Here I demonstrate how the suitability of alternative management options to promote the retention of biodiversity can change dramatically when fundamental ecological processes are considered. We developed and applied both species-level and metacommunity semi-mechanistic modelling approaches, for a variety of taxonomic groups in different regions of Australia. Incorporating key processes (dispersal, community assembly, plasticity, genetic adaptation) not only altered the projected outcomes for species and communities, but also changed the identification of the most effective management response to retaining biodiversity into the future. While these new modelling techniques advance our capacity to account for ecological processes in biodiversity projections, a key challenge for future research will be to identify the suitable level of complexity for semi-mechanistic biodiversity models, to best balance realism and tractability.

Keywords: biodiversity, metacommunity, modelling, scenarios, tropical forest, restoration, configuration, protected areas, genetic adaptation

*Speaker

Linking biodiversity and ecosystem services: Can the difference in functional traits of introduced plants be used to estimate potential changes to ecosystem services?

Ryan Blanchard * [1,2], Patrick O'farrell [1], David Richardson [2]

[1] Council for Scientific and Industrial Research (CSIR) – South Africa
[2] Centre of Excellence for Invasion Biology (CIB) – South Africa

Better understanding the relationships between biodiversity and ecosystem services will provide key insights into the impacts of changing species communities at a landscape scale. Little is known about the processes by which introduced species affect the delivery of ecosystem services, and the degree to which they do. Given that ecosystem processes are largely governed by the combinations of species traits within communities, impacts may be better understood by the relationship between the traits of native and non-native species. In this study, we aimed to understand the impact of introduced plants, used for commercial purposes, on ecosystem functioning using plant functional traits. We used three leaf traits (leaf dry matter content, leaf nitrogen content and leaf phosphorous content) to characterise the functional composition of natural communities to determine functional diversity within an ecosystem service hotspot in Eastern Cape, South Africa. These were used to compare changes in species composition across four different land-use types. Using some of the newest approaches to link functional traits with ecosystem services we provide a test case using data from our study. The results indicate that understanding the per capita effect of individual species is important to determine overall contributions to ecosystem service provision. We discuss the merits and challenges of these approaches and provide a key insight into the methods available to researchers. Furthermore, we highlight the potential to assist decision makers by assessing potential tradeoffs in ecosystem service provision.

Keywords: plant functional traits, land, use, invasive alien plants, biofuels

*Speaker

Moving from biodiversity to functional diversity (also at large spatial scales)

Katrin Böhning-Gaese * [1,2], Matthias Schleuning [3]

[1] Senckenberg Biodiversity and Climate Research Centre (BiK-F) – Senckenberganlage 25 60325 Frankfurt (Main), Germany
[2] Goethe-University Frankfurt am Main – Grüneburgplatz 1 60323 Frankfurt am Main, Germany
[3] Senckenberg Biodiversity and Climate Research Centre (BiK-F) – Germany

Assessments for science-policy interfaces like IPBES require reliable information on the state of biodiversity and ecosystem services at large spatial scales. Ideally, scenarios and models exist that project the impact of drivers, such as climate or land-use change, on biodiversity, ecosystem functioning and ecosystem services into the future. While traditional biodiversity models are strong in projecting biodiversity, they are usually weak in representing ecosystem functions and services. In contrast, traditional ecosystem service models are strong in reflecting ecosystem functions and services, but weak in incorporating biodiversity. Here, we show avenues on combining our understanding of the relationship between biodiversity and ecosystem functions from small-scale experiments with trait-based functional biodiversity research and large-scale biodiversity modelling. The combined approaches make use of functional traits, such as eco-morphological characteristics of species, to project species into a multidimensional trait space. These approaches take into account the distribution of species in functional space, and can quantify, for example, the redundancy or uniqueness and originality of individual species. The position of species in functional trait space can also be described using aggregate measures for the whole community such as functional identity, functional richness and functional dispersion. In a second step, it is possible to assess the impact of climate and land-use change, or other types of human impact, on functional trait space. Finally, we can link changes in functional trait space to changes in ecosystem functions and ecosystem services. The advantages of these approaches are that multiple measures of functional diversity can be linked to spatial gradients in environmental factors, for example climatic and land-use gradients, and to projected future scenarios of climate and land-use change. Furthermore, these approaches can be applied to a wide variety of organisms from the terrestrial, freshwater and marine realm and a wide range of ecosystem functions and services. Given the increasing availability of data on the geographic distribution of organisms and their traits, these approaches open up promising avenues for the development of better models on biodiversity, ecosystem functions and ecosystem services also at large spatial scales.

Keywords: biodiversity, functional diversity, biodiversity models, traits, land, use change, climate change

*Speaker

Land-use impacts on species, functional and phylogenetic diversity of bee communities in Europe

Adriana De Palma * [1,2], Simon Ferrier [3], Andrew Hoskins [3], Michael Kuhlmann [1,4], Simon Potts [5], Stuart Roberts [5], Andy Purvis [1,2]

[1] Natural History Museum (NHM) – United Kingdom
[2] Imperial College London – United Kingdom
[3] CSIRO Land and Water – Australia
[4] Zoological Museum, University of Kiel – Germany
[5] Centre for Agri-Environment Research, University of Reading – United Kingdom

Agricultural intensification and urbanisation are important drivers of biodiversity change in Europe, as elsewhere. The impact of these changes on bee communities has been of particular concern for researchers and policy makers alike: bees can be adversely impacted by human-dominated land uses, such as intensively-managed cropland, and can potentially indicate wider ecosystem health. Different facets of community diversity – species, functional and phylogenetic – may be more or less sensitive to these pressures, however, as well as making different contributions to ecosystem service provision. To obtain a comprehensive understanding of human impacts on biodiversity, it is therefore important to assess multiple, complementary indices of diversity to capture these different aspects. We have used data from 1446 sites and 337 species to model statistically how species, functional and phylogenetic diversity of European bee communities vary with a variety of human pressures including land-use class, land-use intensity, human population density and proximity to roads. We combine the resulting models with pressure data to estimate the 'intactness' of bee communities for the whole of the EU27 region-that is, how much diversity has been lost relative to a natural or semi-natural baseline-and to map the fine-scale (1km2 resolution) spatial patterns of bee community intactness, highlighting spatial mismatches between different aspects of diversity.

Keywords: pollination, phylogenetic diversity, functional diversity, biodiversity loss, human impacts

*Speaker

Linking biodiversity and ecosystem functioning by functional traits – a case study on frugivorous birds and woody plants

Katja Schiffers *† [1], Matthias Schleuning [1], Matthias Dehling [2], Katrin Böhning-Gaese [1]

[1] Senckenberg - Biodiversity and Climate Research Centre – Germany
[2] University of Canterbury – New Zealand

Ecosystem functioning has been shown to generally respond positively to different measures of biodiversity. However, ultimately, ecosystem functioning depends on the functional traits of the species forming the communities and their pattern in functional trait space rather than on biodiversity itself. Thus, for a mechanistic understanding and the projection of ecosystem functioning to scenarios of future environments, we need to translate information on the taxonomic community composition to the functional community composition. In this talk, I will exemplify the above idea with community and trait data of frugivorous birds and woody plants. I will show how relevant traits can been identified in this system and demonstrate the roles of the traits' identity and complementarity. Finally, I will discuss conceptual ideas on the role of redundancy in functional trait space and its potential to buffer ecosystem functioning against environmental change.

Keywords: biodiversity, ecosystem functioning, functional traits, redundancy, frugivorous birds, woody plants

*Speaker
†Corresponding author: katja.schiffers@senckenberg.de

Modelling plant trait diversity in tropical forests

Kirsten Thonicke * [1], Boris Sakschewski [1,2], Alice Boit [1], Lourens Poorter [3], Marielos Pena-Claros [3], Werner Von Bloh [1]

[1] Potsdam Institute for Climate Impact Research e.V. (PIK) – P.O.Box 601203 D-14412 Potsdam, Germany
[2] University of Potsdam – Germany
[3] Wageningen University (NETHERLANDS) – Netherlands

Functional diversity plays an important role for vegetation dynamics, ecosystem productivity and ecosystem resilience. Classifying vegetation as plant functional types (PFTs) has been hypothesized to oversimplify ecosystem response to climate change and the role functional diversity plays in it. With the development of an flexible individual trait approach in the dynamic global vegetation model LPJmL-FIT we are able to investigate how changes in plant trait diversity influence ecosystem function. When considering trade-offs between traits we are able to reproduce observed trait distributions in tropical South America and follow observed spatial gradients of important plant functional traits. We show which role plant trait diversity plays under future climate change to maintain ecosystem function, such as carbon storage, for ecosystem resilience. Modelled results have wider implication for the provision of ecosystem services.

Keywords: plant trait diversity, tropical forest, ecosystem modelling, ecosystem resilience, future climate change

*Speaker

Quantitative assessment of the protective effect of mountain forests against rockfalls

Sylvain Dupire *† [1], Frédéric Berger [1], Thomas Curt [2]

[1] Université Grenoble Alpes, Irstea, UR EMGR – Irstea – 2 rue de la Papeterie-BP 76, F-38402 Saint-Martin-d'Hères, France, France
[2] Irstea, UR RECOVER – Irstea – 13182 Aix-en-Provence, France

Mountain forest ecosystems provide a wide range of ecosystem services (ES) essential for human life and activities. In addition to the renewable wood resources they represent, mountain forests constitute a biodiversity reserve and contribute to the environmental and landscape attractiveness. A significant part of mountain forests also protect people and infrastructure against natural hazards such as rockfalls, flash floods, erosion or avalanches. Thus, in France, approximately 20% of the Alpine forests protect the population against rockfalls.

The assessment of this particular ecosystem service is important for an efficient land-use planning and for the safety of mountainous populations. However, it is a difficult task for both rockfall experts and forest managers. Accurate and simple tools are therefore required to efficiently evaluate the rockfall hazard reduction due to the presence of forest on the slope.

These last years, 3D-rockfall models gradually integrated the presence of forest in their simulation processes. For instance, Rockyfor3D simulates the trajectories of single, individually falling rocks, in three dimensions by calculating successive sequences of free flights through the air, rebounds on the slope surface, and impacts against trees. Using this model, rockfall simulations can be run with and without forest on the same slope surface. The comparison of the results from the forested and non forested scenarios allows an objective and quantitative assessment of the rockfall hazard reduction due to the presence of forest. These models are useful when working at local scale. However, it is not possible to use them on a large scale because of the required accuracy of input data and high computational power needed.

In this study, Rockyfor3D was used to simulate rockfalls propagation on virtual terrains for 3886 different forest stands located in all the French Alps. Three quantitative indicators of the rockfall hazard reduction were defined and calculated from the results of the simulations for each forest stand. Finally, the relations between forest characteristics and compositions and rockfall reduction were investigated.

Our results showed that the three indicators are strongly linked with three forest characteristics : the basal area, the mean diameter at breast height and the length of forest in the maximum slope direction. These three parameters were used to define six levels of protection only based on forest characteristics. Our results demonstrated that forest ecosystems dominated by shade-tolerant tree species presented a higher protective effect than those dominated by pioneer tree species. Finally, forests with the highest tree species biodiversity showed better protective effect than those dominated by only one specie, especially if the latter were a conifer.

*Speaker
†Corresponding author: sylvain.dupire@irstea.fr

Keywords: Ecosystem service, Mountain, Forest, Natural hazard, Rockfall, Modelling, Indicators

New tools and methodological framework to study spatial drivers of deforestation, degradation and regeneration and forecast possible futures in Madagascar

Clovis Grinand *† [1,2], Ghislain Vieilledent [3,4], Tantely Razafimbelo [5], Jean Roger Rakotoarijaona [6], Martial Bernoux [2,7]

[1] Etc Terra (Association Etc Terra) – Etc Terra – 127 rue d'Avron, 75020 Paris, France
[2] Ecologie fonctionnelle et biogéochimie des sols et des agro-écosystèmes (EcoSols) – Institut de recherche pour le développement [IRD] : UMR210 – place Viala, 34060 Montpellier, France, France
[3] Biens et services des écosystèmes forestiers tropicaux (CIRAD) – CIRAD : UPR105 – Campus international de Baillarguet 34398 Montpellier Cedex 5, France
[4] European Commission, Joint Reasearch Centre (JRC) – Joint Research Center of the European Commission, Institute for Environment and Sustainability, I-21027 Ispra, ITALY, Italy
[5] Laboratoire des Radio Isotopes (LRI) – Route d'Andraisoro, 101 Antananarivo, Madagascar, Madagascar
[6] Office National de l'Environnement (ONE) – Ave Rainilaiarivony, Antaninarenina BP 822, Madagascar, Madagascar
[7] Food and Agricultural Organization of the United Nations (FAO) – Viale delle Terme di Caracalla 00153 Rome, Italy, Italy

Deforestation, land degradation and land regeneration are rapid and complex processes that greatly impact climate regulation, ecosystem services provision and population well-being. Appropriate response through land use planning and intervention should be enlighten by a comprehensive drivers analysis and spatially explicit risk and opportunity information which could be easy to update as new data become available or updated. In this study we explore the use of global high resolution vegetation change, biophysical and socio-economical dataset to map deforestation, land degradation and regeneration suitability. A stratifed sampling scheme was applied to collect change/no change calibration points which were then modeled using the random Forest algorithm. The predicted change class membership was used as a surrogate of probability of land change. These potential change maps were used to draw three scenarios of quantity change for the two next decades (2015-2035) based on past trends and an alternative scenario. We finally assessed these outputs with respect to existing protected and non-protected areas.

Historical observation during 2001-2014 display clear patterns of high deforestation (1774 ha / y), high degradation (2737 ha/y) and low regeneration (302 ha/ha) over the 1,600,000 ha study area. Amongst the twelve predictors, distance to natural habitat and elevation were the most important for the three land transitions. Slope, aspect, and distance to villages also influence land change to a lesser extent. Validation of land change models showed satisfactory figures with ROC values above 0.8 and overall accuracy above 75%. Business as usual scenarios highlighted the large areas under deforestation and degradation threat within the western forest edge of the study area and within one of the two national parks (Midongy). Nevertheless, the neighboring and non-forested areas of this latter park showed the highest opportunity for land regeneration.

*Speaker
†Corresponding author: c.grinand@etcterra.org

The approach was successful to provide a comprehensive assessment of driver of deforestation and potential change maps as well as expert-based prospective view that appeared to be useful for feeding land use negotiation about alternative land use trajectory. The tool is adaptive, easy to replicate and produce good suitability estimates, thus we believe it could be used in developing countries to both meet their REDD+ requirements (reference emissions levels) and used in targeting their local interventions (control in protected areas) or promote large scale sustainable land management strategies.

Keywords: Ecosystem Services modeling, Deforestation, Land degradation, Land regeneration, REDD+, driving forces

Ecosystem services in hinterlands: How cities connect to their resource bases

Daniel Haberman * [1], Elena Bennett [2]

[1] Department of Natural Resource Sciences, McGill University – 21, 111 Lakeshore Road, Sainte-Anne-de-Bellevue, Montreal, Quebec H9X 3V9, Canada
[2] Department of Natural Resource Sciences and School of Environment, McGill University – 21, 111 Lakeshore Road, Sainte-Anne-de-Bellevue, Montreal, Quebec H9X 3V9, Canada

Nearly all of the wild lands of the planet have been exploited, either actively or passively, to produce ecosystem services (ES); this is especially true in the heavily managed and resource-rich areas close to major cities. These areas, referred to as hinterlands, have served the important role throughout history of supplying a suite of ES needed to satiate the demand for ES in their neighboring city. Yet globalization has resulted in highly specialized ES production in hinterlands, possibly resulting in inequitable sharing of the burden to supply ES globally. To date, global ES models have not done a good job of describing how hinterlands around the world are used to provide ES, or how the interactions between multiple ES change in different areas of the planet. There is also a poor understanding of the mechanisms that cause hinterlands to specialize their ES production into distinct ES bundles; is it simply because they are biophysically more suitable to produce certain services or is there more to it than that?
We use globally available spatial datasets and models to produce maps of ES supply for 8 ES; 3 provisioning (crop, livestock, water), 4 regulating (carbon sequestration, carbon storage, air quality, water quality), and 1 cultural (nature recreation). We examine how these ES are produced in the hinterlands of all cities with populations greater than 500 000 (n=768). We use an affinity propagation clustering algorithm to group hinterlands into similar ES bundles, and then apply a multinomial logit model to test the effects of biophysical and socio-economic variables in determining which bundle a hinterland will fall into.
We find that hinterlands cluster into 7 different ES bundles. Notably, hinterlands in India and China that are used mainly for food production at the expense of other ES are respectively identified as distinct bundles from the global hinterland. We also find a distinct bundle of ES that forms at extremely high levels of wealth featuring mainly regulating services. We find that, with the exception of precipitation, biophysical variables explain very little about which ES will be produced in hinterlands. Instead, the amount of urban sprawl has a much greater effect. We also find that levels of wealth significantly contribute to which ES will be provided, though it is unclear if this is a cause, an effect, or both. Wealth was positively correlated with all regulating ES and negatively correlated with all provisioning ES, potentially suggesting that we are undermining the long-term resilience of the worlds most poor.

Keywords: ecosystem services, global, urban, bundle

*Speaker

Synergies between ecosystem services, socioeconomic demand and landscape. The case of a socio-ecological system in a mexican peri-urban highland temperate forest

Antonio Villanueva * [1,2], Eugenio Figueroa B. [3], Jacques Imbernon [2], Galicia Sarmiento Leopoldo [4], Jurgen Hoth [5]

[1] AgroParisTech (Ecole Doctorale ABIES) – AgroParisTech – France
[2] Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD) – Centre de coopération internationale en recherche agronomique pour le développement [CIRAD] – Campus international de Baillarguet, 34398 Montpellier, France
[3] Universidad de Chile [Santiago] – v. Libertador Bernardo O'Higgins 1058, Santiago, Chile
[4] Departamento de Geografía Física, Instituto de Geografía, Universidad Nacional Autónoma de México (UNAM) – Circuito Exterior s/n, Ciudad Universitaria, C.P. 04510, Coyoacán, Mexico
[5] Conservation International NGO – 2011 Crystal Drive, Suite 500 Arlington, VA 22202, United States

The links between ecosystem services, ecosystem functions and ecological processes should be a tool for social-ecological systems planning and management. Despite ongoing academic debates related to the instability on these concepts and to their relationships with landscapes or ecosystems.
The highland temperate forests located on the outskirts of Mexico City ("Bosque de Agua") are a priority area for ecosystem conservation due to the high level of endemic species and the ecosystem services provided to the people of the central valley of Mexico. The Bosque de Agua is affected by human pressures, particularly urban sprawl but also mining, agricultural expansion and illegal logging. These human pressures are causing forest fragmentation and connectivity loss between natural ecosystems.

Ecosystems services have become a key concept in understanding the way humans benefit from ecosystems. In Mexico, a pioneer national scheme of payment provides compensation for forest conservation and National Protected Areas Policy (ANP's) that is assumed to jointly produce services related to biodiversity conservation, carbon storage, water and scenic beauty, but little is known about the spatial correlations among these services.

This research analyzes the spatial congruence between ecosystem services, by considering the biophysical potential of service provision and socioeconomic demand. Ecosystem services have different spatial distributions; they are correlated with landscape composition and policies of conservation. Spatial synergies exist between national parks, payment scheme (PES) and ecosystem services provided.

A spatial model applied allows then to spatialize the biophysical potential of ecosystem services by type of landscape. The composition of landscape has been quantified using morphological indices derived from "landscape ecology" theory to show the actual condition of the "ecosystem

*Speaker

services" in the "Bosque de Agua".

The study was thus able to identify several "hot-spots" crucial to the longterm sustainability of the area, which will demand proactive and well-targeted public policies.

Keywords: Ecosystem services, socio, ecological systems, highland temperate forests, social perception, biophysical modeling, Mexico.

Spatial modelling the social perception of ecosystem services. The case of a socio-ecological system in a mexican peri-urban highland temperate forest.

Antonio Villanueva * [1,2], Jacques Imbernon [2], Eugenio Figueroa B. [3], Galicia Sarmiento Leopoldo [4]

[1] AgroParisTech (Ecole Doctorale ABIES) – AgroParisTech – France
[2] Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD) – Centre de coopération internationale en recherche agronomique pour le développement [CIRAD] – Campus international de Baillarguet, 34398 Montpellier, France
[3] Universidad de Chile [Santiago] – v. Libertador Bernardo O'Higgins 1058, Santiago, Chile
[4] Departamento de Geografía Física, Instituto de Geografía, Universidad Nacional Autónoma de México (UNAM) – Circuito Exterior s/n, Ciudad Universitaria, C.P. 04510, Coyoacán, Mexico

Despite ongoing academic debates related to the instability on the concepts of ecosystem services, ecosystem functions and ecological processes, and to their relationships with landscapes or ecosystems, the links between them should be a tool for social-ecological systems planning and management.
The highland temperate forests located on the outskirts of Mexico City ("Bosque de Agua") are a priority area for ecosystem conservation due to the high level of endemic species and the ecosystem services provided to the people of the central valley of Mexico. The Bosque de Agua is affected by human pressures, particularly urban sprawl but also mining, agricultural expansion and illegal logging. These human pressures are causing forest fragmentation and connectivity loss between natural ecosystems.

Recent research on social perception of ecosystem services have been focused on social preferences of services through the analysis of socio-demographic and socio-economic proxies. However, few studies are considering how the different landscapes and their spatial distribution affect social preferences. This study analyzes the relationships between social preferences of service in 12 peri-urban communities of the Bosque de Agua (846 respondents).

The results show the differences of social perception according to the spatial scale and the type of landscape. At the regional level, the perceived values of ecosystem services are very high. However, the analysis by landscape types reveals important variations between landscapes. Three groups are identified according to the social value of the ecosystem services: (i) Landscapes dominated by forest and wetlands with the higher value (4 or 5), (ii) Landscapes with human settlements with lower value (0 or 1) and (iii) Agricultural and grassland landscapes with heterogeneous values around intermediate values (3 or 4).
Socio-demographic proxies explain quite well the differences of perception, but the concept of scarcity used in economics can be also related to the perceived values. On the contrary, the feeling of attachment to a landscape reveals a weak association with social value of ecosystem services. A spatial probabilistic model applied allows then to spatialize the preferences revealed

*Speaker

of ecosystem services by type of landscape.

Keywords: Ecosystem services, socio, ecological systems, highland temperate forests, social perception, spatial modeling, Mexico.

Evaluate benefits of wetland protection: application to the Conservatoire du Littoral' sites in the Bay of Arcachon ou Arcachon basin

Ambre Diazabakana * [1]

[1] Vertigo Lab – Vertigo Lab – 87 quai des queyries, 33000 Bordeaux, France

On its 40th anniversary, the Conservatoire du Littoral wished to highlight the economic value of the natural sites under its protection. This economic valuation has been held through the assessment of the goods and services provided by natural sites on the one hand, and the assessment of economic benefits of its land acquisition policy for the sustainable management of french coastal ecosystems to 2050, on the other hand. Challenges were twofold: first to demonstrate the important contribution of the Conservatoire du Littoral's sites to the local, regional and national economy; and then to reveal net economic benefits generated by the long-term protection policy conducted by the Conservatoire du Littoral. This work constitutes an advocacy tool toward a better coastal areas protection and, more specifically, in favor of the action offered by the Conservatoire du Littoral and its partners. This study also provided guidelines to strengthen the protection of the coastline and guide the management of sites in order to maximize their contribution to the coastal economy.
The study focused on eight case studies in France : in the Arcachon Basin, the South Finistère, the Etang de Thau, the Maures' coastline, Corsica, the estuary of the Orne, the Somme Bay and the Estuary of Charente.

For each of these case studies, prospective scenarios were built modelling evolution in the provision of ecosystem services based 1) on pressures threatening ecosystems and 2) management activities related to the acquisition strategy of the Conservatoire du Littoral. These scenarios influenced the provision of ecosystem services in time and space through:

- A variation of the ecosystems' surface. This first model used cartographic tool;

- A variation of ecosystems' health;

- Variations in surface and health.

Comparing the values of services for each management scenarios with a baseline scenario (without management), we estimated the net benefits of the land acquisition policy led by the Conservatoire du Littroal.

The comparison of scenarios in order to reveal the benefits of management, is still a method rarely used in France. However this valuation method brings relevant economic results for decision makers. These results could motivate future management choices without reinforcing or criticizing past choices. Although it is weakened by a lack of available data anda considerable

*Speaker

number of assumptions, this method offers interesting prospects for achieving a sustainable and integrated management of natural sites based on the conservation of ecological functions and ecosystems.
The Conservatoire du Littoral's sites in the Arcachon Basin, former diked areas, will illustrate this study in the context of the French strategy for integrated management of coastline. Indeed, the methodology developed allowed in this specific case study to model the maritime reconnection strategy undertaken by the Conservatoire to manage its coastline.

Keywords: prospective, economic valuation of ecosystem services, benefits of the protection, advocacy

Valuing forest ecosystem services and disservices- Case study of a protected area in India

Karachepone Ninan * [1], Andreas Kontoleon * † [2]

[1] Centre for Economics, Environment and Society (CEES) – 201 Divya Jyothi Apts, Friends Colony, Koramangala ST Bed, Bangalore, India
[2] University of Cambridge – 19 Silver Street, Cambridge, United Kingdom

This study seeks to estimate the value of forest ecosystem services provided by a protected area in a biodiversity hotspot in India. The novelty of the study rests in that it addresses some of the shortcomings identified in existing literature by also estimating the value of several intangible benefits ignored in most valuation studies as well as estimating the value of disservices of forests such as wild life damages and forest fires, and the added value obtained by intact forests as compared to from alternative landscapes for selected services. Using primary and secondary data, and economic valuation techniques the study suggests that the total (net) economic value of ecosystem services provided by the Nagarhole national park in Karnataka, India is quite high and significant. The total net value of benefits (i.e. value of services minus disservices) provided by the park ranges between US$13-148 million per annum or US$204-2294 per ha per annum using alternate valuation methods. More significant is that the added value of benefits from the park is higher as compared to from alternative landscapes considering just three ecosystem services i.e. water and soil conservation, and carbon sequestration services. If these are factored in decision making it could strengthen the economic case for conserving forests in bio-rich tropical countries such as India where there is great pressure to relax forest laws and divert forests to meet pressing development needs.

Keywords: Economic valuation, forest ecosystem services, disservices, added value, net benefits

*Speaker
†Corresponding author: ak219@cam.ac.uk

Evolutionary approach for mapping biodiversity priorities in Brazil

Ubirajara Oliveira * [1], Adriano Paglia [1], Antonio Brescovit [2], Claudio Carvalho [3], Daniel Silva [4], Daniela Teixeira [5], Felipe Leite [6], João Batista [1], João Barbosa [5], João Stehmann [1], John Ascher [7], Marcelo Vasconcelos [5], Paulo Marco [8], Peter Löwenberg-Neto [9], Priscila Dias [10], Viviane Ferro [11], Adalberto Santos [1], Britaldo Filho [1]

[1] Universidade Federal de Minas Gerais (UFMG) – Brazil
[2] Instituto Butantan (IB) – Brazil
[3] Universidade Federal do Paraná (UFPR) – Brazil
[4] Instituto Federal Goiano (IFGoiano) – Brazil
[5] Independent researcher (NI) – Brazil
[6] Universidade Federal de Viçosa (UFV) – Brazil
[7] National University of Singapore (NUS) – Singapore
[8] Universidade Federal de Goiás (UFMG) – Brazil
[9] Universidade Federal da Integração Latino-Americana (UFILA) – Brazil
[10] Universidade Federal de Lavras (UFL) – Brazil
[11] Universidade Federal de Goiás (UFG) – Brazil

We have built a model to map biodiversity priorities across Brazil that integrates evolutionary approach with a set of biodiversity variables. The model uses a comprehensive dataset (circa of 500 thousand geo-records) on vertebrates, arthropods and angiosperms from which we derived indices of beta-diversity, species richness, area of endemism, endemicity, phylogenetic endemism and phylo-beta-diversity. Results indicate that 10% of the Brazil has high biological relevance for conservation with relatively good sampling effort. These areas encompass 87% of the species and 92% of the evolutionary lineages contained in our dataset. Sensitivity analyses show that the use of few biodiversity variables or only one group of organisms (vertebrates for example) is not sufficient for identifying biodiversity conservation priorities. Yet, vast areas of Brazil, especially in the Amazon, still lack biological inventories, making it impossible to compare their relevance in relation to other areas where biological knowledge is high. Some regions with high biological relevance are located in areas of deforestation pressure or of highly fragmented forest remnants, making them either a conservation or a restoration priority.

Keywords: Biodiversity conservation priorities, evolutionary conservation

*Speaker

Systematic Mapping of Biodiversity and Ecosystem Services Scenarios Research Applied to Landscape Restoration.

Francisco Carvalho * [1], Andre Acosta† [1], Jean Paul Metzger‡ [2], Antonio Saraiva [2]

[1] Fundação de Apoio a Pesquisa do Estado de São Paulo (FAPESP) – Brazil
[2] Universidade de São Paulo (USP) – Cidade Universitaria - 05508-090 São Paulo, Brazil

The conversion of natural habitats into agricultural systems, together with habitat fragmentation, biological invasions and global climate change are threatening biodiversity and our own well-being. Restoration of natural habitats is a strategy to reverse or, at least, decelerate the trend of species loss and ecosystem services decline. Indeed, many countries are committed to restore large amounts of natural land cover (e.g. COP21). However, effective restoration policies should take into account multiple factors and scenarios, related with land use expansion, climate change, landscape conditions, socio-economical factors, among others. Consequently, the use of scenarios could be a powerful tool to increase chances of restoration success and citizen engagement. We performed an extensive literature survey using ISI Web of Science and Scopus databases searching for studies that used scenarios approaches for biodiversity and ecosystems services with restoration purposes (hereafter "*restoration scenarios*"). We used the search keywords combination [(restor* OR revege* OR reforest* OR rehabilit* OR remediat*) AND (ecosystem* OR land* OR habitat OR site OR regional OR global) AND (biodiversity OR "Ecosystem servic*" OR *populat* OR species) AND scenario*)]. As a result we obtained a total of 1298 publications. Based on their abstract content we filtered the publications, leading to select 444 works strictly related to restoration scenarios. We categorized publications according to the scenario typology proposed by IPBES assessment, type of environment, scale, organization level, climate zone of study site and actors involved. We found a predominance of articles using exploratory scenario approaches (71%) dealing mainly with habitat (55%) and plants (36.8%) at broad scale (> 100 ha; 65%), on forests (47%) and in temperate environments (78%). In addition, the main actors were researchers (65%), doing non-participatory research (top-down; 76%) at the landscape organization level (49%). There was a small number of participatory research (bottom-up; 18%) and none with non-governmental actors. We identified a lack in species-level research (< 2%) and studies at global and regional scale (both < 2%). We did not find publications related to invertebrates or about marine environments. There was an extremely low representation of publications developed for polar or boreal climatic zones (_˜4%), urban environments (_˜1%) and applying ex-post assessment scenarios (_˜3%). Our results pointed out important research gaps in the application of scenarios for restoration purposes and also detected a demand for governmental participation on restoration initiatives as an active actor, beyond providing financial support for researches.

*Speaker
†Corresponding author: andreluisacosta@gmail.com
‡Corresponding author: jpm@usp.br

Keywords: scenario approaches, restoration, biodiversity, ecosystem services, IPBES

Comparing diversity projections under climate and land-use change: a call for a community effort with harmonized driver data

Carsten Dormann * [1], Jörg Steinkamp [2], Andrea Janeiro Otero [3], Thomas Hickler† [2]

[1] Biometry and Environmental System Analysis, University of Freiburg – Freiburg, Germany
[2] BIK-F, Senckenberg – Germany
[3] Biometry Environmental System Analysis, Uni Freiburg – Germany

Scientists use various approaches to make projections about how environmental changes will affect diversity. Some of them employ data and regression-like approaches, others first principles and process models, and others again higher-level "ecological laws", or even expert-based guesses. Do they differ much? What do they actually state for the same future scenario? What are the key sources of uncertainty of these different approaches, and are some less sensitive to such uncertainty? How will expectable and black-swan surprises (a.k.a. known vs. unknown unknowns) affect their predictions?
This talk will outline an open and unfunded platform to produce such a biodiversity projection comparison. We propose a two-stage process: first, we will provide a common set of "now" and "then" data for which different groups can compute their predictions of diversity. In the second stage, we shall expand the number and possibly type of scenarios (different spatial scales and emission pathways) for a more comprehensive analysis.

Keywords: model intercomparison, biodiversity, global, land cover, climate

*Speaker
†Corresponding author: thomas.hickler@senckenberg.de

Temporal, spatial, and sampling heterogeneities in species distribution modeling. The case study of the data-poor area of the Kerguelen Plateau.

Charlène Guillaumot * [1], Alexis Martin [2], Marc Eléaume [2], Thomas Saucède [1]

[1] UMR 6282 Biogéosciences – Laboratoire Biogeosciences Dijon – Univ. Bourgogne Franche-Comté, CNRS, 6 bd Gabriel F-21000 Dijon, France
[2] Muséum national d'histoire naturelle (MNHN) – Ministère de l'Ecologie, du Développement Durable et de l'Energie, Ministère de l'Enseignement Supérieur et de la Recherche, Muséum National d'Histoire Naturelle (MNHN) – 57, rue Cuvier - 75231 Paris Cedex 05, France

Modeling species and community distributions over wide expanses of waters like the Southern Ocean presents strong interests for improving our understanding of marine life in remote and little-investigated areas.
However, available presence-only data – used to generate habitat models - often rely on the compilation of heterogeneous datasets produced from different campaigns, and might thereby introduce strong spatial (sampling strategies and areas) and temporal biases (environmental changes over the sampling period) in models. As such heterogeneities influence the performance of models, assessing their impact is critical to the relevance of modeling procedures.

The present study aims at testing the influence of different temporal and spatial biases in widely used modeling procedures (MaxEnt and BRT), using a dataset from the Kerguelen Plateau, for four echinoid species which display contrasted ecological niches and distribution areas. Presence-only data were compiled from different oceanographic campaigns (led over a long time period : 1872-2015) and show significant sampling heterogeneities.

The influence of data quantity and distribution in space and time on model performances was analyzed and compared with the influence of present and future environmental changes. BRT and MaxEnt abilities to project the models over different time periods was also tested, by comparing models based on contemporaneous data with models extrapolated from the past.
Results were used to model species potential shifts predicted from IPCC A1B scenarii proposed for 2100 and 2200 AD; they were compared with the magnitude of changes recorded in the past (1955-2012).

Keywords: species distribution modeling, prediction, heterogeneities, sea urchins, Kerguelen plateau

*Speaker

Integration of feedbacks among global change drivers, biodiversity measurements and ecosystem services through meta-analysis.

Alejandra Parreno *† [1], Owen Petchey [1], Michael Schaepman [1], Bernhard Schmid [1], Norman Backhaus [1]

[1] University of Zurich (UZH) – Switzerland

Global change drivers comprise climate change, habitat change, pollution and over-exploitation, among others. Biodiversity plays an important role in the maintenance and resilience of ecosystems to global change. While there are numerous studies reporting the effects of these drivers in changes in biodiversity levels and disruption of ecosystem services, data is reported in heterogeneous ways and remains largely scattered. Moreover, there are synergistic effects of global change drivers for which is necessary to also look at feedbacks and interactions as opposed to studying them in isolation. In this short communication, I will show progress towards understanding the feedback effects at different scales between land use change, species richness and net primary productivity. With a preliminary meta-analysis at global scales, I integrate data on the effects among these variables between the years 2000-2016 in order to report a net effect and highlight global patterns hard to appreciate with non-quantitative, non-integrative reviews.

Keywords: global change, biodiversity, ES, meta, analysis, integration, data sharing

*Speaker

†Corresponding author: alejandra.parreno@ieu.uzh.ch

Ecological modeling of restoring Mediterranean lagoon: global sensitivity analysis and model behavior

Romain Pete * [1], Stéphanie Mahevas [2], Martin Plus [3], Rutger De Wit [1], Annie Fiandrino [1]

[1] Centre for Marine Biodiversity, Exploitation and Conservation (MARBEC) – Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER), Centre National de la Recherche Scientifique - CNRS, Institut de Recherche pour le Développement - IRD (FRANCE), Université Montpellier II - Sciences et Techniques du Languedoc – Avenue Jean Monnet CS 30171 34203 Sète cedex, France
[2] Institut Français de Recherche pour l'Exploitation de la Mer - Nantes (IFREMER Nantes) – Université de Nantes – Rue de l'Ile d'Yeu - BP 21105 - 44311 Nantes Cedex 03, France
[3] Dynamiques de l'Environnement Côtier (DYNECO) – Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER) – Technopole Brest-Iroise, BP 70, 29280, Plouzané, France

Since the 1960s, Mediterranean lagoons have experienced nutrient over-enrichment due to nitrogen and phosphorus loadings from watersheds resulting in eutrophication of these semi-enclosed ecosystems. Since the 2000s, public policies have been pursued aiming to reduce these external nutrient loadings. This policy has already initiated restoration processes in some of the lagoons. However key questions remain on the time required for restoring all the biological compartments of the ecosystem the identification of maximal allowable N and P loadings to lagoons that are compatible with the maintenance of good ecological state as requested by the EU water frame directive. A numerical tool, based on the LOICZ methodology, is developed as an attempt to bring quantitative responses to these questions. GAMELAG is a simple physical box-model simulating water and nutrients fluxes at the interface of the lagoon coupled to key biogeochemical processes to evaluate matter fluxes between relevant biological compartments. If mathematical models have been largely used to understand ecosystems and to identify relevant management measures to achieve biodiversity objectives, the sensitivity of spatial and temporal scales used to model the system remains poorly studied. We hereby present a model exploration study using global sensitivity analysis to assess model behavior regarding to temporal scales of driving forces.

Keywords: eutrophicated lagoon ecosystems, box, models, global sensitivity analysis, uncertainties

*Speaker

Exploring local communities' perceptions towards forest ecosystems and co-management programmes: A case of Malawi

Linda Chinangwa * [1]

[1] United Nation University, Institute for the Advanced study of Sustainability – 5-53-70 Jingumae, Shibuya-ku, Tokyo 150-8925, Japan., Japan

Central to forest co-management programmes, is the involvement of local communities in the sustainable management and utilization of forest ecosystems. As such local people's knowledge and perceptions of trends in forest ecosystems are important in designing and implementing effective forest co-management programmes. Therefore, this study used focus group discussions, key informant interviews and a survey of 155 households from communities living around Zomba-Malosa and Ntchisi forest reserve to explore how local people perceive the trends in forest ecosystems and its impacts on their wellbeing. The study further explores how local communities perceive the forest co-management programs currently being implemented in their area, with regards to its impacts on forest conditions and welfare. The study shows that communities perceive a decline in forest ecosystems and biodiversity and a decline in the availability and accessibility of forest resources such as firewood, timber, and poles. The results also show that communities are aware of the multiple objectives of the program and that its success depends on the active participation of multiple stakeholders including local communities. However, communities perceive a limited political will among authorities to actively involve them in the management of the program. The study also reveals that local people expect the programme to enhance community participation in decision making; improve access to and availability of forest resources; and improve community infrastructure. Finally, the study shows that the communities perceive the current wellbeing impacts of the forest co-management program as minimal, however they are willing to pay to participate in the programs activities in order to safeguard the perceived future benefits of a conserved forest ecosystem.

Keywords: Local people, co, management, welfare, forest conditions

*Speaker

Impact of climate change scenarios on the fish production in the Northern Humboldt Current Ecosystem

Ricardo Oliveros-Ramos *† [1], Yunne Shin [2], Dante Espinoza-Morriberón [1], Carlos Romero [1], Vincent Echevin [3]

[1] Instituto del Mar del Perú (IMARPE) – Peru
[2] Institut de Recherche pour le Développement (CRH, IRD) – CRH – Institut de Recherche pour le Développement, CRH, Research Unit MARBEC (UMR 248), avenue Jean Monnet, CS 30171,, France
[3] Institut de Recherche pour le Développement (IRD) – Institut de Recherche pour le Développement – Adresse du siège - Le Sextant 44, bd de Dunkerque, CS 90009 13572 Marseille cedex 02, France

The Northern Humboldt Current Ecosystem (NHCE) is the more productive ecosystem in terms of fish and sustains the worlds largest small pelagic fishery, the Peruvian anchoveta fishery. A cooling of this system has been observed during recent decades but the potential regional impacts of rising atmospheric CO2 concentrations on upwelling dynamics and productivity are still unknown. In this work, we use the ecosystem model OSMOSE to forecast the impact on fish production of several scenarios of climate change in the NHCE. The OSMOSE model is forced by plankton production from ROMS-PISCES, IPSL CM5A-LR and GFDL-ESM2M models for the period 2006-2100. For each model, optimistic (RCP 2.6) and pessimistic (RCP 8.5) environmental scenarios are considered. Total fish production and landings for each model and scenario are compared under statu quo and zero fishing effort for all main fisheries. Our results show that the impact of fishing may be as strong as climate to explain future variability in fish production, reason why the design of management procedures must be an important part of the mitigation of the impacts of climate change in the NHCE.

Keywords: Climate change, Peru, upwelling ecosystem, multi, species models, OSMOSE model

*Speaker
†Corresponding author: ricardo.oliveros@gmail.com

Social Cost of Marine Juvenile By-catch: A Study from India

Jyothis Sathyapalan * [1]

[1] Centre for Economic and Social Studies (CESS) – Nizamiah Observatory Campus, Begumpet P O Hyderabad, Telangana, India

The increasing biodiversity loss is a major global concern today. India is endowed with rich marine biodiversity areas. Nevertheless, overfishing has been reported as one of the important drivers of marine biodiversity loss. This is an unintended consequence of fishing on marine biodiversity, a cost to the society. This study provides a review of overfishing and estimates of social cost in terms of juvenile species loss besides suggesting solution to minimize the cost so that the stock of fish resources and biodiversity are sustained while simultaneously harvesting fish for human purposes. The estimate of social cost is based on case study conducted in Andhra Pradesh state, which is located in the east of India with a coastal line of 974 kilometers and a continental shelf of 33,227 km2. This study has made use of secondary data on fish landings from the government of Andhra Pradesh and the Central Marine Fisheries Research Institute to examine the trends and composition of species harvested over time in Andhra Pradesh. Two primary data sets collected during the period 2013-14 and 2014-15 have been used to estimate the proportion and values of catch and juvenile by-catch. As far as juvenile catch is concerned, we segregated them based on length at first maturity. The study also shows that 59.8 percent of the future biomass is forgone due to juvenile catch that needs to be regulated. The cost of juvenile catch can be avoided by regulating the excessive fishing efforts used for harvest. One of the best strategies to regulate by-catch harvest is to make fishers take into account the implicit cost incurred by them due to juvenile catch besides providing simple juvenile reduction technologies with a fair amount of subsidy.

Keywords: Marine Biodiversity, By, catch, Social Cost, India

*Speaker

Examining the usefulness of trophic level-based indicators in assessing ecosystem-level changes in the ocean

Lynne Shannon * [1], Marta Coll [2,3], Yunne Shin [4,5], Jodie Reed [1,4], Alida Bundy [6], Kristin Kleisner [7]

[1] Marine Research Institute, University of Cape Town (Ma-Re, UCT) – Private Bag X3 Rondebosch 7701, South Africa
[2] Institut de Recherche pour le Développement (UMR EME 212) – Institut de recherche pour le développement [IRD] : UMR212 – France
[3] Institute of Marine Science (ICM-CSIC) – Spain
[4] Institut de Recherche pour le Développement (CRH, IRD) – CRH – Institut de Recherche pour le Développement, CRH, Research Unit MARBEC (UMR 248), avenue Jean Monnet, CS 30171,, France
[5] Université de Montpellier – – – Université de Montpellier, Place Eugène Bataillon, Bâtiment 24, CC 093, 34095 Montpellier cedex 05, France, France
[6] Fisheries and Oceans Canada – Fisheries and Oceans Canada, Bedford Institute of Oceanography, 1 Challenger Drive, Dartmouth, NS B2Y 4A2, Canada, Canada
[7] Environmental Defense Fund, 18 Tremont St., Ste. 850, Boston, MA 02108 – Environmental Defense Fund, 18 Tremont St., Ste. 850, Boston, MA 02108, United States

Trophic level (TL)-based indicators have been widely used to examine fishing impacts in aquatic ecosystems and induced biodiversity changes. However, there has been much debate concerning the use of landings data from commercial fisheries to calculate TL indicators because commercially caught species and their relative catches likely do not reflect the whole ecosystem and strongly depend on fishing strategies. Subsequent studies have started to look at survey-based and model-based TL indicators. Further, the use of a fixed TL per species in the calculation of TL-based indicators has been questioned, given that species' TLs vary with ontogeny, as well as over time and space. In this contribution, we report on two studies that contribute to this discussion: (i) a data-based extensive evaluation of a variety of trophic level indicators across nine well-studied marine ecosystems using model-based,survey-based, and catch-based TL indicators as well as detailed regional information, data on fishing history, fishing intensity, and environmental conditions, to examine how well TL indicators capture fishing effects at the community level of marine ecosystems; (ii) a fishing scenarios study using four different ecosystem modelling approaches in contrasted ecosystem case studies to examine the performance of TL-based indicators in tracking the effects of fishing pressure when using fixed species TL versus species' TL varying depending on the fishing scenarios. Results of the first study highlight that the differences observed between TL indicators' trends are dependent on the data source, and are not attributable to an intrinsic problem with TL-based indicators. All three data sources provide useful information about the structural changes in the ecosystem as a result of fishing, but only model-based indicators were found to represent fishing impacts at the whole ecosystem level. From the second study, we conclude that overall, TL-based indicators calculated with variable species' TL have a greater capacity for detecting the effects of fishing pressure than when using fixed species' TL. Across TL-based indicators, survey-based TL indicators displayed the greatest consistency regarding the use of fixed or variable species' TL and the highest capacity for detecting fishing effects. This work supports the use of community-

*Speaker

based indicators over catch-based indicators to explore the impacts of fishing on the structure of marine ecosystems.

Keywords: trophic level, fishing effects, indicators, fishing scenarios, trophic model

Accounting for Expert Knowledge Uncertainty in Species Distribution Modelling

Aidin Niamir *† [1,2], Andrew Skidmore [2], Antonio-Román Muñoz [3], Bert Toxopeus [2], Raimundo Real [3]

[1] Senckenberg Biodiversity and Climate Research Centre (BiK-F) – Senckenberganlage 25 60325, Frankfurt am Main, Germany
[2] Faculty of Geo-Information Science and Earth Observation of the University of Twente (ITC) – Hengelosestraat 99 7514AE, Netherlands
[3] Faculty of Sciences of the University of Malaga (UMa) – Campus de Teatinos s/n, 29071 Malaga, Spain

Conservation managers often reply on the knowledge of experts where data and information describing species distributions are scarce or unobtainable. However, experts' knowledge is always subject to uncertainty and accounting for this uncertainty into a modelling procedure poses a challenge. We propose using the Dempster-Shafer Theory of Evidence (DST) to accommodate the uncertainty in experts' knowledge, and assess how this might affects the performance of species distribution models. We applied DST to model the distribution of both well-known, and poorly-known species in mainland Spain. We invited experts to form a knowledge domain, and asked them through online questionnaires to express their knowledge on the habitat preferance of species by assigning an occurance probability value per given environmental variable. Experts were also asked to acknowledge their confidence level on the assigned probability values. Then we calculated evidential belief functions and combined them using Dempster's rules of combination. We evaluated and compared the calibration and discrimination capacity of the DST models with several commonly used data-driven models using independent speceis occurence data. The DST models yield similar spatial patterns in comparision to data-driven methods for both groups of species. Although the habitat of the well-known species were well-discriminated, DST models were generally underestimating the habitat favourability. In contrast, the models for the poorly-known species were well-calibrated though the discrimination capacity remained low. Our proposed approach offers a practical alternative where knowledge of species' geographic distribution is needed, and the distribution data is not sufficient. The particular strength of the developed approach is that it explicitly accommodates experts's knowledge uncertainty. It also provides a framework to propagate and aggregate uncertainty, and it capitalizes on the range of data sources usually considered by an expert.

Keywords: Knowledge Uncertainty, Species Distribution Models, Dempster, Shafer Theory of Evidence, Expert Knowledge, Ignorance

*Speaker
†Corresponding author: niamir@gmail.com

Estimating future ecosystem services provision: A model inter-comparison on the European Scale

Clara Veerkamp * [1], Rob Alkemade [1], Rob Dunford [2], Paula Harrison [3]

[1] PBL Netherlands Envrionmental Assessment Agency (PBL) – Netherlands
[2] University of Oxford (UOXF) – United Kingdom
[3] Centre for Ecology and Hydrology (CEH) – United Kingdom

Spatial modeling is a commonly used tool in ecosystem service assessments to estimate the availability of ecosystem services (ES) in current and future environments. Ecosystem service modelling has rapidly developed, and is increasingly used in policy support and spatial planning. However, no standard method exists to model ES and diverse ways for modelling (and mapping) ES have evolved (Crossman et al. 2013). The various approaches result in significant uncertainties, often not addressed in ecosystem services studies (Schulp et al. 2014). Differences between modelling approaches and ignorance of uncertainties may hamper interpretation of model results and may result in end-users such as policy-makers being wrongly informed.
The EU FP7 project OpenNESS is developing tested approaches for modelling ES which can be used to assess best management practices for sustaining ES delivery. As part of the OpenNESS project, we applied two ES-models: 1) the GLOBIO model within the global Integrated Assessment Modelling Framework IMAGE 3.0 (Stehfest et al. 2014) and 2) the CLIMSAVE Integrated Assessment Platform (IAP) (Harrison et al. 2015). Both models assess consequences of environmental changes on various ecosystem services (Schulp et al. 2012, Dunford et al. 2015). The approaches differ in their model techniques, detail and resolution and geographical scope, as GLOIBO is a global model, whereas CLIMSAVE is developed for Europe.

Using these two models, we analyzed four EU-level scenarios (Priess et al., in prep) and compare the model results for land use change, changes in biodiversity and ecosystem service delivery. Comparing the results allows the derivation of common trends, patterns and relationships, as well as facilitates the understanding and quantification of uncertainties.
In this presentation, we will concentrate on the differences between scenario quantification in the two different modelling approaches (i.e. model assumptions and parameterization). We will compare the results by systematically describing the most important drivers (e.g. population change, agricultural productivity) within each model and how these impact on land use change. Next, changes in ES provision as a result of land use change will be compared between the two models spatially and quantitative to identify a bandwidth of ES provision under the different scenarios.

Keywords: scenario analysis, modeling ecosystem services, model inter, comparison, European scale

*Speaker

CoPalCam: Exploring the complexities of the Palm Oil Supply Chain in Cameroon. Participatory modelling, stakeholder engagement and capacity building through role playing games.

Eglantine Fauvelle *† [1], Patrice Levang [2], Emmanuel Ngom [3], Anne Dray [4], Ludovic Miaro [5], Durrel Nzene Halleson [5], Claude Garcia [4,6]

[1] CIRAD UMR System – CIRAD – France
[2] Institut de Recherche pour le Développement / Center for International Forestry Research – Cameroon
[3] Ministry of Agriculture and Rural Development (MINADER) – Cameroon
[4] Forest Management and Development (ForDev - ETH) – CHN F 75.2 Universitaetstraase 16 8092 Zurich, Switzerland, Switzerland
[5] WWF Regional Office for Africa (WWF) – WWF Regional Office for Africa, Yaounde Hub Panda house Rue la Citronelle PO Box 6776 Yaounde Cameroon, Cameroon
[6] CIRAD UR Forêts et Sociétés – CIRAD : UPRForêts et Sociétés – France

Experts tend to have a deep but narrow understanding of their field, and this expertise is known to increase their cognitive bias. The case is of the palm oil supply chain in Cameroon is no different. Decisions are taken at all levels of the supply chain, with far fetching, often unforeseen, sometimes unwanted consequences in terms of sustainability, efficiency and environmental impact. To overcome this challenge, we developed, as part of the OPAL (Oil Palm Adaptive Landscape) project, a role playing game, CoPalCam, with stakeholders from the oil palm belt of Cameroon. CoPalCam can be used by small growers, cooperatives, plantation companies, downstream industries, and policy makers to explore the resilience of the supply chain and the complex and non-linear ways in which their decisions interact.
In a first step, the model was calibrated and validated during playing sessions with 28 oil palm smallholders, 3 extension officers and 5 representatives of two of the five companies processing fresh fruit bunches (FFB) into crude palm oil (CPO) in 3 regions of Cameroon. These game sessions refined our collective understanding of the supply chain. The discussions generated feedback that could be integrated in the model, or act as "take-home" messages for the participants, be they academics or stakeholders.

The second step was to use this game to organise a discussion with 8 members of the Cameroonian Palm Oil Supply Chain Regulation Committee. This institution involves representatives of the ministries of Finance, Trade and Agriculture, refiners and soap-industries, agro-industries and the main smallholders' association (UNEXPALM) and is an ideal platform to explore alternative solutions to the issues faced by the supply chain.

The outcome of this last session was (i) a better understanding by the Committee members of the individual strategies of producers and transformers and their impacts, (ii) a request to repeat the exercise to explore potential solutions to the problem of insufficient production in

*Speaker
†Corresponding author: eglantine.fauvelle@cirad.fr

Cameroon, and (iii) the opportunity to use the game as part of the awareness creation program the Government is running in order to foster the creation of cooperatives.

It's not often that policy makers at the highest level are able to experience first hand the complexity of the systems they manage. Our model, our game, and the scenarios that we can explore with it gave them this opportunity, in an non-threatening, low stakes environment. It could shatter their "illusion of understanding" and by creating alternative forms of interaction, enabled them to discuss openly sensitive topics. It also gave them the opportunity to reflect on their own role and capacity of action: where is the real power driving change in the supply chain? Our method and the boundary objects it creates are an efficient way to build the capacity of the managers and policy makers in dealing with complexity and let them explore alternative scenarios balancing development and conservation imperatives. Their uptake by the Government is a proof of that.

Keywords: Participatory Modelling, Role Playing Game, Transdisciplinarity, OPAL, ComMod

Capacity building for developing scenarios and models of biodiversity and ecosystem services in China

Dandan Yu * [1,2]

[1] Bojie Fu – China
[2] Nan Lu – China

In response to global, regional, and thematic assessment and decision support activities undertaken or facilitated by IPBES, China has currently stressed the importance of capacity building in developing scenarios and models of biodiversity and ecosystem services. However, most current studies lack a detailed description of the principles and quantitative comparison of scenarios and models of biodiversity and ecosystem services. It may hinder further development and application of scenarios and models in China. Here, we firstly presented three broad classes of models, i.e., scenarios and models of indirect and direct drivers, biodiversity and ecosystem properties, and ecosystem services. Then, we comprehensively reviewed the key input and output, model types, analytical technique, model structure, spatial coverage and resolution, uncertainty in outputs of the models, combinations of scenarios and models used in (large) assessments, and introduction and application of scenarios and models in China. Finally, we discussed data gap for introduction and application of scenarios and models in China, by synthesizing existing data integration platforms funded by the National Natural Science Foundation of China, high-resolution earth observation system, ground-based monitoring and information-processing capabilities, and capabilities to acquire and process economic and social data. Thus, we suggest that the Chinese government and scientific community should establish a collaboration with global observation networks to enhance capacity building in the following aspects: 1) observing, data mining and statistics; 2) acquirement and processing of economic and social data with robustness; 3) promotion of data shared principles by making a commitment to long-term funding for collection, calibration and release of datasets; 4) integration of monitoring and evaluation mechanisms into policy-making at all levels to ensure that information will be available and accessible to all.

Keywords: Models, Scenario analysis, Data gap, Assessment

*Speaker

GFBio - building a sustainable and service-oriented biodiversity data infrastructure for Germany

Marco Schmidt* [1], Katja Schiffers † [1], Aidin Niamir †

[1], Claus Weiland [1], Eva-Maria Gerstner [1], Thomas Hickler †

[1,2], Katrin Böhning-Gaese †

1,2

[1] Senckenberg Biodiversity and Climate Research Centre (BiK-F) – Senckenberganlage 25 60325 Frankfurt (Main), Germany
[2] Goethe-University Frankfurt am Main – Grüneburgplatz 1 60323 Frankfurt am Main, Germany

In the context of biological research, data is being produced in larger quantities each year. The need for such data also increases, as research approaches are increasingly data-driven and relying on 'big data'. However, data are often scattered, hard to integrate, and their long-term preservation is not secured. To overcome this mismatch, the German Federation for Biological data (GFBio) is building a sustainable and service-oriented national data infrastructure to facilitate data sharing and stimulate data intensive science. GFBio has been in an intensive design and development phase since 2014, resulting in deployment of a stable portal framework, considerable progress towards mobilizing and harmonizing data sources, and prototype implementations of advanced applications and services. GFBio includes representatives from key institutions, including major data providers in the biological and environmental sciences community. Established and well-proven data archiving infrastructures like Pangaea for environmental data and Germany's major natural history collection data repositories will be improved and integrated in a new infrastructure with a common technological and organizational outline.
The approach of GFBio is to support sustainable research data management throughout the 'data life cycle' on an integrated platform: from data management plans in research proposals, via data collection, quality assurance, data deposition and publication to secure long-term archiving and semantic integration. GFBio has developed a series of web-based tools for retrieval, aggregation and visualization of organismic and environmental data (VAT), supporting scientists addressing fundamental questions of biodiversity research and making large-scale computing resources for data-intensive processing available.
Senckenberg Biodiversity and Climate Research Centre established an office to align GFBio internationally, fostering information and data exchange, networking and cooperations, and to promote GFBio beyond national frameworks. Here, we present the conceptual framework of GFBio, along with some of VAT tools and functionalities, with particular focus on needed data infrastructures, data products, and data support for the development of biodiversity and ecosystem services, and to promote data management as funded part of science projects.

*Corresponding author: marco.schmidt@senckenberg.de
†Speaker

Keywords: Biodiversity, Biological, Ecosystem Services, Informaiton, Knowledge, Data Management, Germany

Author Index


ScenNet