Sustaining ecosystem services in forest landscapes

Book of Abstracts

IUFROLE WG Conference in Tartu, Estonia, 2015

IUFRO Landscape Ecology Working Group Conference, 2015: Abstracts

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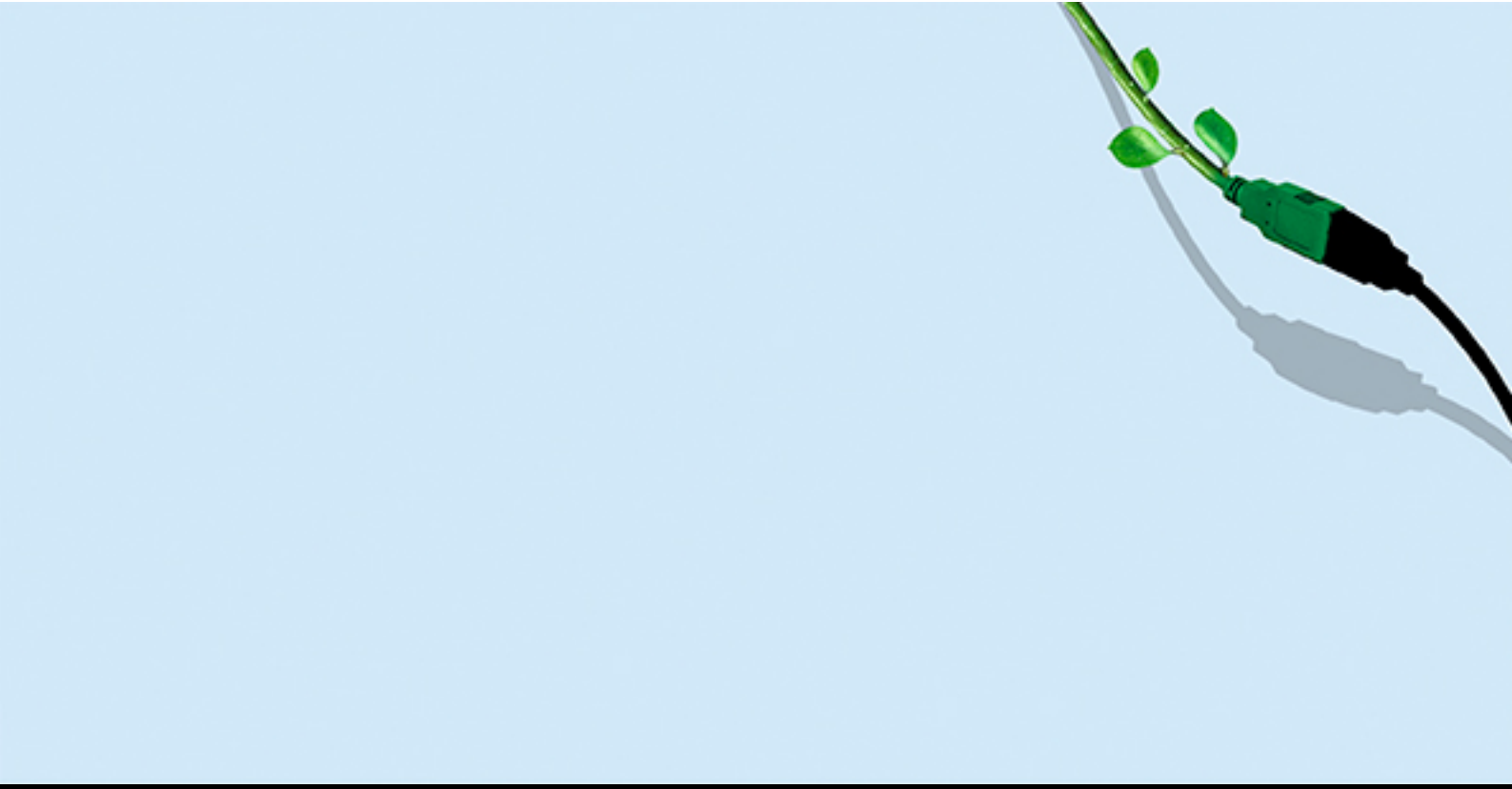


Keynote presentations

Butterbach-Bahl, Klaus

Forest ecosystem and climate and environmental change - what does this mean for biosphere-atmosphere exchange of atmospheric trace gases?

IUFRO Landscape Ecology Conference, 23-30 August 2015, Tartu, Estonia

Klaus Butterbach-Bahl

Institute of Meteorology and Climate Research, Atmospheric Environmental Research (IMK-IFU)

Karlsruhe Institute of Technology, Garmisch-Partenkirchen, Germany

Forests ecosystem cover approx. 30% of the world terrestrial surface, or around 4 billion hectare. Forests do not only function as major sinks (and sources) for atmospheric CO_2 but also as significant sources and sinks of other environmental important atmospheric trace gases, namely NO, N_2O and CH_4. The importance of forests as regulators of atmospheric concentrations of these trace gases is undebated, but how this function might change in view of on-going climate and environmental changes (e.g. atmospheric N deposition and increases in atmospheric CO_2 concentrations) remains a matter of debate, which hampers to analyse and predict possibly feedbacks. E.g. increases in temperature and atmospheric CO_2 concentrations might favour denitrification and forest soil N_2O emissions, while declining precipitation or more erratic rainfall might result in the opposite. Providing a set of examples I will discuss current knowledge and research perspectives to better understand the future role of forests as regulators of the atmospheric composition.

Klaus Butterbach-Bahl is Adjunct Professor at Albert-Ludwigs University of Freiburg, Germany; Head of Department "Atmosphere/ Biosphere Interactions and Global Change" at IMK-IFU, Karlsruhe Research Centre, Germany; Guest-Research-Professor at the Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China; Principal Scientist at the International Livestock Research Institute, Kenya.

His research interests include: feedback of global environmental changes on terrestrial ecosystems and biosphere-atmosphere-exchange of environmental important trace substances (N_2O, NO_x, CH_4, CO_2);

identification and characterisation of microbial processes involved in N- and C-trace gas production and consumption; process oriented modelling of carbon/nitrogen turnover in terrestrial ecosystems; calculation of emission inventories of biogenic trace substances on regional and global scales.

Chen, Jiquan

Landscape Ecology Working Party in Current and Future Society

IUFRO Landscape Ecology Conference, 23-30 August 2015, Tartu, Estonia

Jiquan Chen

Michigan State University, USA

Twenty-five years ago, with the leaderships of Dr. Thomas Crow and Dr. Bostjan Anko, the Landscape Ecology Working Party (WP) was formed. Ten conferences have been organized across the globe since then with a principle of "Although electronic communication helps us stay in contact, there is no substitute for the productive discussions that occur both formally and informally as these meetings". The purpose of our WP meetings are to share information, experiences, and perspectives. These conferences serve this purpose very well and demonstrate resounding successes. A few characteristics of the WP distinguished us from others. First, our conferences are the lifeblood of our group. We now have a core group of active members who have continuously promoted and expanded the collegial and social network. Second, we have placed our major effort into supporting junior researchers and students from developing countries. Third, we made efforts in developing edited books or special issues in scientific journals after every conference. Finally, we expanded our initiatives by collaborating with other organizations such as other WPs of IUFRO and IALE. Through these collaborations, our "landscape perspective" has been greatly enhanced. Our missions aim to bridge the gap between the theory of landscape ecology and its application in managing forest resources. This mission can only be achieved with a broad support of our members by orchestrating specific activities. As we move toward the Anthropocene, many pressing issues now face the globe and its societies need to adopt a landscape perspective. Both the scientific community and policy makers now realize the importance of integrating human and natural systems to sustain ecosystem services for society. Our understanding and endeavors in searching for potential solutions cannot be successful without a strong landscape perceptive, simply because human decisions are often made at this scale.

Dr Jiquan Chen, a Professor at the CGCEO/Geography at the Michigan State University and an ESA Fellow and an AAAS Fellow. He has authored >260 scientific articles and 11 books with a total citation`~13000 since 1992. He is broadly interested in ecosystem science and landscape ecology. His research on forest edges, three dimensional canopy structure, ecosystem carbon and water fluxes, energy balance, riparian zone management, and fire ecology has been funded through >80 research grants and has been very influential in ecology, carbon/water cycle, forest management, and micrometeorology.

Dr. Chen served as a chair of the Landscape Ecology Working Party of the IUFRO (2004-2013), the chief scientist for the US-China Carbon Consortium (USCCC), the Organizing Professor and Chair for the Advanced Ecology Lectures at Fudan University (2004 – 2010), and a distinguished university professor at the University of Toledo prior to Michigan State University.

He has been an associate editor for several scientific journals (e.g., Landscape Ecology, Agricultural and Forest Meteorology, Forest Ecology and Management, Journal of Plant Ecology, Journal of Integrative Plant Biology). He was a Bullard Fellow at Harvard University (1999-2000) and recipient of the Outstanding Faculty Research Award (2006) and the Outstanding Research of the Sigma Xi in (2004) at UT. Dr. Chen will be one of the editors for Springer's book series "Landscape Ecology".

See more at http://lees.geo.msu.edu.

de Groot, Rudolf

Role of ecosystem services in sustaining forest landscapes: ecological and economic considerations

IUFRO Landscape Ecology Conference, 23-30 August 2015, Tartu, Estonia

Rudolf de Groot

Wageningen University, Netherlands

Forests provide a wide range of services, many of which are of fundamental importance to our health, livelihood, economy and general well-being. Yet, despite national regulations and international commitments, degradation of forest ecosystems, fragmentation of landscapes and loss of biodiversity continue on a large scale which undermines the functioning and resilience of our landscapes. In addition to the environmental and social costs, ecosystem and landscape degradation has huge economic costs: a recent publication estimated the damage, mitigation and repair costs associated with the loss of ecosystem services globally between 4 – 20 trillion US$/year (Costanza et al, 2014).

This presentation will briefly reflect upon the underlying ecological and economic concepts and debates, referring among others to the Millennium Ecosystem Assessment, www.maweb.org and the TEEB-study on "The Economics of Ecosystems and Biodiversity", www.teeweb.org . Examples will be provided how the ecosystem services concept can help in practice to analyse trade-offs in land use change in a more balanced way to achieve more sustainable (forest) landscapes. An important conclusion is that money spent on nature (and forest) conservation and restoration should not be seen as a 'cost' but as an investment that generates high economic returns, in addition to ecological and socio-cultural benefits, provided we are honest about all the externalities involved. For more information see: www.es-partnership.org

Costanza, Robert., Rudolf de Groot, Paul Sutton, Sander van der Ploeg, Sharolyn J. Anderson, Ida Kubiszewski, Stephen Farber, R.Kerry Turner. 2014. Changes in the global value of ecosystem services. Global Environmental Change 26 (2014): 152-158

Rudolf de Groot is Associate Professor in Integrated Ecosystem Assessment & Management with the Environmental Systems Analysis Group of Wageningen University, the Netherlands. He is a Landscape Ecologist by training and has worked for almost 30 years on ecological-economic analysis of impact of land use and climate change on ecosystem services as a tool for sustainable planning and management. De Groot published over 100 scientific papers, including 2 books, and was involved as Coordinating Lead author in the UN-supported Millennium Ecosystem Assessment (2001-2005) www.maweb.org and the global study on "The Economics of Ecosystems & Biodiversity" (TEEB 2008-2010) www.teebweb.org .

He is a member of the Editorial Board of several Journals, including "Conservation Letters" and "Regional Environmental Change" and Editor-in-Chief of the International Journal on "Biodiversity Science, Ecosystem Services and Management" and co-founder and Topic Editor of the new Elsevier Journal "Ecosystem Services: Science, Policy & Practice".

He is Special Advisor on Ecosystem Services of the IUCN Commission on Ecosystem Management (CEM), member of the Steering Committee of the UNEP International Resource Panel, and Chair of the Ecosystem Services Partnership www.es-partnership.org, a worldwide network to enhance the science and practical application of ecosystem services assessment.

Lawrence, Anna

Learning at landscape scale: Human dimensions of adaptive management in old countries

IUFRO Landscape Ecology Conference, 23-30 August 2015, Tartu, Estonia

Anna Lawrence

University of the Highlands and Islands, UK

At its simplest, adaptive management can be defined as management through deliberate experimentation, and learning is central in this approach to resilience. Adaptive management is still rooted firmly in the biological side of ecology, while the social or human dimensions tend to receive less attention. It is also fair to say that most adaptive management is conducted in the so-called “new world”, where large areas of semi natural forest, usually under public ownership, are available for planned experimentation as an integral part of resource management. The challenge remains, of how to build experimentation and learning into more fragmented landscapes under mixed public and private ownership.

One approach is to take a more bottom-up view, and explore what professionals are doing as they respond to the pressures and drivers of environmental change. These adaptations of practice take place within a cultural and institutional landscape, as well as an ecological landscape. It is relevant therefore to consider within the concept of human landscape ecology, the ways in which knowledge is developed and shared in the context of governance processes and structures.

The talk will consider new data about local experiments by foresters, who feel that scientific advice and institutional guidance is insufficient for conventional approaches to forest planning. These experiences are used as a lens to reconsider some of the orthodoxies and experiences of adaptive management, and ask how we can help innovation and knowledge to connect within landscapes.

Anna Lawrence's work focuses on the human dimensions of forestry, and on wider issues of environmental management and conservation. She is an Honorary Professor at the University of the Highlands and Islands, and directs her writing and consultancy business through Random Forest.

Following a decade of work in international development spanning 25 countries, she established and led the Human Ecology Programme at Oxford University's Environmental Change Institute during 2001-2007, where her research focused on participatory research for adaptive forest management; institutional change in forestry; and organisational adaptiveness. For the last seven years she was head of social research at Forest Research, the research agency of the UK's Forestry Commission. She is also a Visiting Professor in the Forest and Nature Conservation Policy Group, University of Wageningen, Netherlands. These roles enable her to bridge perspectives from the academic, policy and practice domains, an approach which supports her dedication to knowledge innovation and sharing for ecological resilience.

She has degrees in botany (University of Cambridge), forestry (University of Oxford) and international development (PhD from University of Reading). She is on the editorial board for Citizen Science: Theory and Practice; and having returned in recent years to her native Scotland, she is also an editorial advisor for Scottish Forestry.

Mönkkönen, Mikko

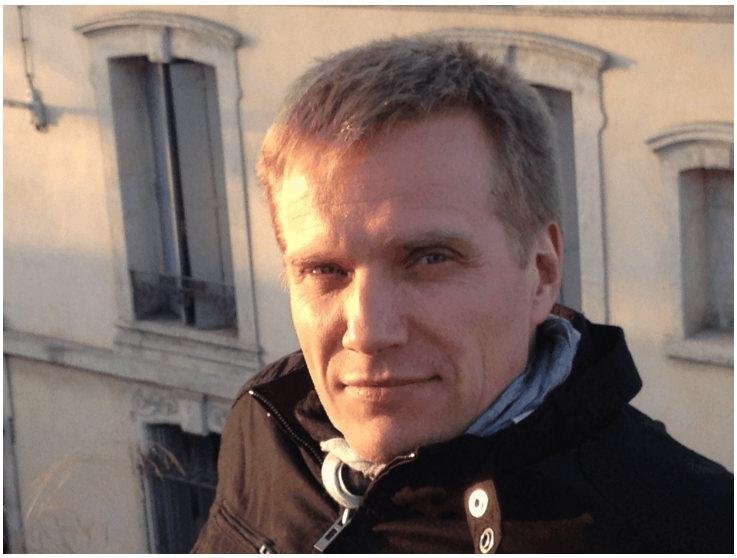
Solving conflicts among conservation, economic and social objectives in boreal production forest landscapes

IUFRO Landscape Ecology Conference, 23-30 August 2015, Tartu, Estonia

Mikko Mönkkönen

University of Jyväskylä, Finland

Reconciling biodiversity conservation with increasing demand of natural resources and human well-being from ecosystems requires that ecological, economic and social values of the landscape are taken into account in decision-making. Joint production of economic and social values together with maintaining biodiversity is a challenging planning problem because of potential conflicts among the objectives. Using landscape level data on 30000 stands simulated over 50 years with seven alternative management options I will first demonstrate conflicts among timber production, other ecosystem services and maintaining biodiversity. I show that the conflicts among objectives are typically complex and asymmetric, and particularly timber production is in strong conflict with other objectives. Then, I apply multi-objective optimization tools to resolve the conflicts. In many cases, with careful and informed forest management planning at landscape level it is possible to achieve compromise solutions that incur minimal losses in the objectives. However, achieving these efficient plans requires a diverse combination of management options. I conclude that the current emphasis on management that aims at maximizing timber production causes considerable social and ecological costs.



Mikko Mönkkönen is a professor in applied ecology at the University of Jyväskylä, Finland, and a scientist with broad expertise in biodiversity research including multidisciplinary research programs at the interface between ecology, economics and policy. His recent research has addressed the question how to reconcile biodiversity conservation with increasing demands of natural resources in boreal landscapes under intensive management. This research aims at identifying the ecological, economic and functional values of the landscape, which should be taken into account in forest planning and decision-making. He is a co-founder of Peerage of Science, which is an internationally awarded initiative for improvement of scientific peer-review.

Niinemets, Ülo

How plant "talk" contributes to global change

IUFRO Landscape Ecology Conference, 23-30 August 2015, Tartu, Estonia

Ülo Niinemets

Estonian University of Life Sciences, Estonia

Plants face a multitude of abiotic and biotic stresses with varying severity throughout their life. Climate change involves modification of several environmental drivers, and is predicted to increase the frequency and severity of various abiotic and biotic stresses, including rising temperatures, increasingly uneven distribution of precipitation, and more frequent outbreaks of herbivore and pathogen attacks. As any stress reduces plant CO_2 fixation, enhanced stress frequency and severity are expected to lead to faster rise of atmospheric CO_2 concentration, thereby further exacerbating climate change. On the other hand, plants can importantly modify their own life environment by release of volatile organic compounds (BVOC) that participate in ozone- and aerosol forming reactions in ambient atmosphere and in cloud formation. Apart from constitutive emissions that are present in only some species and are expected to decrease under stress, especially under severe stress, all plants respond to stresses by induced BVOC emissions that serve as signal molecules eliciting stress response pathways and leading to plant acclimation. These induced BVOC emissions, the plant “talk”, also contribute to atmospheric processes and can potentially reduce the stress severity, and accordingly, stress-driven reductions in CO_2 uptake. Thus, the stress responses and acclimation of vegetation to future environmental stresses can importantly modify the speed and magnitude of climate change.

Ülo Niinemets is Professor at Estonian University of Life Sciences, Institute of Agricultural and Environmental Sciences and a member of Estonian Academy of Sciences.

His research interests include: physiology of vascular plants; volatile organic compound emission physiology; plant stress biology; functional relations between plant structure and physiology; global change biology; stress-induced plant volatiles in biosphere-atmosphere system; plant stress in changing climates: from stress responses to acclimation and adaptation.

He has published over 230 scientific publications with a total citation > 10500 and h-index 52. He is an editor or member of editorial board of several plant science and plant physiology journals and book series: Plant, Cell & Environment (editorial board), Oecologia (editor), Journal of Plant Research, (editorial board), Tree Physiology (editor), European Journal of Forest Research (associate editor), Tree Physiology book series (Springer, editor).

San-Miguel-Ayanz, Jesús

Towards the sustainability of European forests and forest ecosystem services

IUFRO Landscape Ecology Conference, 23-30 August 2015, Tartu, Estonia

Jesús San-Miguel-Ayanz

Institute for Environment and Sustainability (IES) of the European Commission Joint Research Centre (JRC)

Addressing sustainability of forest resources in Europe is an extremely complex issue, given the large variety of national peculiarities and diverse interests on the use of these resources in European countries. The need to assess the state of forest resources and the provision of forest ecosystem services in Europe, as a whole, is at the core of the new EU forest strategy, adopted by the European Commission in 2013 and further supported by other EU institutions such as the Council and the European Parliament. Although there is not a EU forest policy, many existing European policies set a stress in European forests, pulling for their use in support of environmental, economic or social policies. Often, the targets set by different sectors are contrasting.

My talk will address the initiatives set by the European Commission with the national forestry administrations to assess the state and condition of forest resources in Europe and ensure the long-term sustainable use of these resources. These activities range from the establishment of research programs and activities and the publication of forest assessment reports, to the setting of binding targets for the different sectorial policies. At the base of these initiatives lays the envisaged Forest Information System for Europe for the provision of factual data on the progress towards the objectives of the EU forest strategy.

Jesus San-Miguel-Ayanz is a senior researcher at the at the Institute for Environment and Sustainability (IES) of the European Commission Joint Research Centre (JRC) http://forest.jrc.ec.europa.eu/. Since his start at the JRC, his activities centered on the monitoring of forests in Europe and the development of European-wide information systems in support of EU forest related policies. He led the conception and implementation of the European Forest Fire Information System (EFFIS), and currently leads the development of a Global Wildfire Information System (GWIS) as a cooperative effort of GEO (Group on Earth Observations) and the Global Observation of Forest Cover - Global Observation of Land Dynamics (GOFC - GOLD) Fire Implementation Team. At present, his work at EU level focuses on the development of the Forest Information System for Europe (FISE), key objective of the new EU Forest Strategy adopted by the European Commission in 2013.

He holds a forest engineering degree from the Polytechnic University of Madrid (1987), and MSc and PhD on remote sensing and geographic information systems (1989 & 1993) from the University of California at Berkeley. He is active in the collaboration with international organizations, being coordinating lead author of the FOREST EUROPE "State of Europe's Forest 2011 & 2015" reports, and member of the FAO/UNECE Team of Specialists on sustainable forest management.

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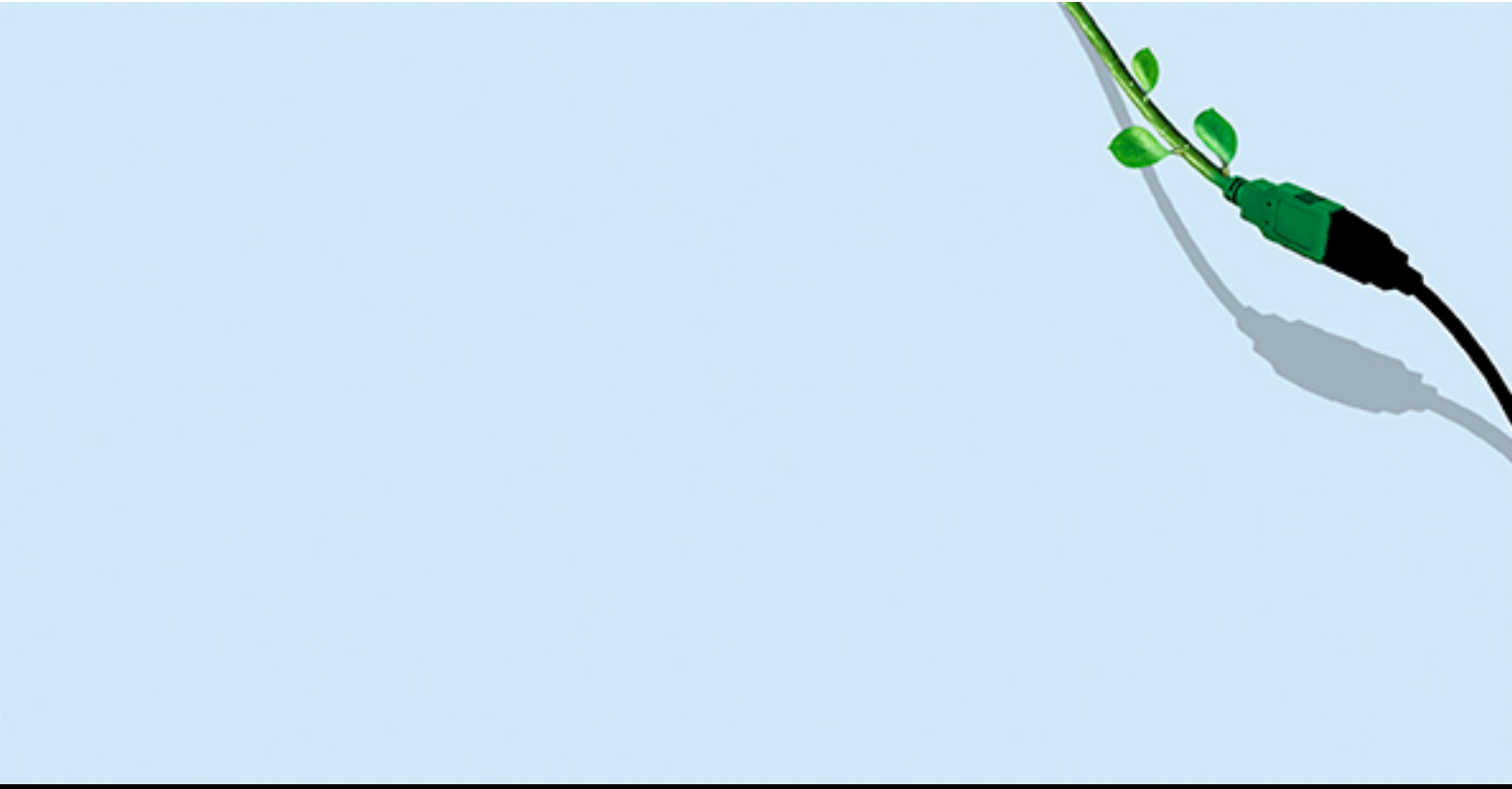

Oral presentations

Aavik, Tsipe

Gene flow of a grassland plant *Lychnis flos-cuculi*: The effect of landscape and network connectivity

Tsipe Aavik[1],Rolf Holderegger[2], Janine Bolliger[2]

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2 Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Switzerland

Understanding the relationship between the structural connectivity of habitats and the functional connectivity of populations is essential for planning effective conservation activities. We evaluated the association between structural and functional connectivity of the wetland plant *Lychnis flos-cuculi* in Swiss agricultural landscape using landscape genetic and network approaches. We used genetic distances among populations as a measurement of functional connectivity. Applying a corridor-based approach, we examined the influence of various landscape elements on genetic distances among populations. In addition, we studied the effect of structural graph-theoretic connectivity measures on gene flow among populations and on genetic diversity within populations of *L. flos-cuculi*. Forests hindered gene flow in *L. flos-cuculi*. Connectivity measures, which take into account the spatial location and distance among populations, were not related to genetic distances among populations. Nevertheless, we detected higher observed heterozygosity and lower inbreeding in populations characterized by higher structural inter-population connectivity. This finding suggested that a spatially coherent network of populations is significant for maintaining the genetic diversity within populations.

Adler, Sven

Modelling the distribution of reindeer lichens as a proxy for the Ecosystem service reindeer meat: An example from the project “National monitoring for assessing and valuating ecosystem services in Fennoscandian alpine and boreal landscapes”

Sven Adler, Malgorzata Blicharska, Anders Esselin, Marcus Hedblom, Henrik Hedenås, Grzegorz Mikusinski, Stefan Sandström, Per Sandström, Johan Svensson, David Wardle, Heather Reese

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Within the project “National monitoring for assessing and valuating ecosystem services in Fennoscandian alpine and boreal landscapes” data provided by the National Inventory of Landscapes (NILS) are used to describe the quantity and quality of Ecosystem services (ESS) in the northern part of Sweden. One aim of the project is to use survey data in combination with remote sensing data to produce maps of the occurrence of single ESS as an input variable for a decision support tool. Generalized Additive Models were used to produce distribution maps for reindeer lichens in order to predict the occurrence of food for reindeers during the winter season by using field data provided by NILS combined with SMD data and different additionally auxiliary data. In the result it was possible to provide a high quality map with a resolution of 30x30m of reindeer lichens occurrences.

Akujärvi, Anu

Mapping carbon budgets in forested landscapes

Anu Akujärvi

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Mapping the effects of forest management on carbon budgets helps decision makers to promote sustainability. Although the drivers of carbon cycle are well-known to scientists, this knowledge has not been adequately implemented in the methods used to assess the supply of various ecosystem services. The widely used methods often assume constant and linearly increasing carbon stocks for land cover classes which may cause remarkably inaccurate estimates. My aims were to develop a method for mapping the carbon budgets of forested landscapes, compatible with the assessment of other ecosystem services. I used the 20x20 m grid database of the National Forest Inventory as a simulation framework and performed the study for the Vanajavesi region in southern Finland. I simulated the carbon stock of biomass using the Motti forest stand simulator and that of soil using the Yasso07 soil carbon model. I mapped the current status of carbon budget based on information about the corresponding site type, tree species and forest age in each grid cell of the study region. The method developed can be used to study both spatial and temporal variation of carbon-related ecosystem services in forested landscapes. The estimates are more realistic and accurate than constant values for land cover classes.

Albert, Christian

Planning Approaches for New Urban Peripheries: Requirements, Approaches, and Research Needs

Christian Albert

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The continued growth of cities worldwide provides tremendous challenges but also promising opportunities for urban planning to guide development into more sustainable pathways. Various scientific planning concepts, approaches and tools are increasingly developed, but their actual usefulness for supporting planning and influence in political decision-making processes has rarely been investigated. The objective of this synthesis paper is to review specific requirements and useful approaches for planning in urban peripheries, and to derive needs for further research and practical experimentation. The paper identifies key issues that cut across different contributions, and synthesizes the insights gained in different case studies. The paper is based on the insights gained from manuscript drafts submitted to the proposed Special Issue on “Sustainable Planning Tools and Approaches for New Urban Peripheries” in Landscape and Urban Planning as well as other contributions to this symposium. As such, this contribution shall spur further discussions among other presenters and the audience, resulting in recommendations on the use, application and combination of planning tools, as well as suggestions for an updated research agenda of planning for sustainable development of urban peripheries.

Angelstam, Per

Spatial and temporal patterns of biotopes and sociotopes in Sweden

Per Angelstam

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Green infrastructures (GIs) for ecological and sociocultural values in forest landscapes should be functional. We modelled the spatial distribution of GIs in terms of three forest types with high ecological values, and three sociotopes with high sociocultural values in 119 municipalities in a rural-urban gradient in Sweden. Forest land without such values should be available for intensive forestry with lower conflict risk. We also estimated the municipalities' potential for physical planning in terms of financial and social capital, and ownership category structure. The area of functional GIs varied considerably among municipalities. Municipalities with a high proportion of functional GIs, thus less available for intensive forestry, were characterised by a stronger tax base, higher population density and lower demographic dependency ratio, and lower proportions of industrial and state forest ownership. We discuss the need for and opportunities of introducing collaborative physical planning to accommodate multiple demands on forest landscapes. We conclude that to accommodate both functional GIs and intensive forestry, a landscape approach including knowledge-based collaboration is needed at multiple-levels of governance and management.

Angelstam, Per

Landscape approaches for sustainable development and sustainability: Learning from global, African, European, Indian and Latin American concepts

Per Angelstam

Swedish University of Agricultural Sciences, Sweden, per.angelstam@slu.se

To realize the vision of SD as a societal steering process, and sustainability as a goal in actual landscapes, a number of concepts have been developed with the aim to create local to regional governance arrangements where actors and stakeholders collaborate to produce and apply new knowledge. The term 'landscape approach' captures this. We review the origins and contents of four international, four African, four European, four Indian and four Latin American concepts designed to implement policies on SD and sustainability on the ground. First, even if the starting points in terms of different dimensions of sustainability and SD processes were different, their evolution has been convergent. All concepts aim at balancing different dimensions of sustainability. However, assessment of governance processes, their outcomes, and the consequences on the ground are rarely evaluated. Second, we argue that new and emerging concepts have much to learn from regionally adapted traditional village and other governance systems that have evolved over long time before the sustainable development discourse was invented. Finally, we stress the need to analyse experiences from implementation of different international concepts by empirical transdisciplinary knowledge production.

Axelsson, Robert

Evaluation of multi-level social learning for sustainable landscapes: Perspective of a development initiative in Bergslagen, Sweden

Robert Axelsson

Swedish University of Agricultural Sciences, Sweden, robert.axelsson@slu.se

To implement policies about sustainable landscapes as a part of rural development based on landscapes' goods, functions and values necessitates social learning about states and trends of sustainability indicators, norms that define sustainability, and adaptive multi-level governance. We evaluate the extent to which social learning at multiple levels for sustainable landscapes occurs in 18 local development initiatives in the network of Sustainable Bergslagen in Sweden. We mapped activities over time, and interviewed key actors in the network about social learning at multiple levels. While activities resulted in exchange of experiences and some local solutions, a major challenge was to secure systematic social learning and make new knowledge explicit at multiple levels. None of the 18 development initiatives used a systematic approach to secure social learning, and sustainability assessments were not made systematically. We discuss how social learning can be improved, and how a learning network of development initiatives could be realised.

Axelsson, Robert

The challenge of transdisciplinary research: Analysis of a Swedish integrative research programme

Robert Axelsson, PerAngelstam

Swedish University of Agricultural Sciences, Sweden, robert.axelsson@slu.se

Transdisciplinary research is emphasized as a way to cope with real world sustainability challenges. We studied a research programme that addressed the challenge of sustainable transport systems, aiming at research with high academic quality, and practical applications to handle environmental problems. After the first out of two 3-year phases the programme was terminated due to poor scientific quality, poor collaboration with end-users and a failure to present convincing plans for future research. In response to this, the researchers initiated an evaluation of their own performance. The results showed that the main problem was poor understanding of integrative research among programme management, end-users and most researchers. The programme management had a background of "consulting-style-researchers". This limited integration and collaborative learning among researchers and end-users. To conclude, transdisciplinary knowledge production requires much time, should start with collaborative learning, and needs facilitation among researchers and end-users. We propose a funding scheme with a long preparatory phase with a lower level of funding. This also tests participating researchers' willingness to leave their comfort zone for a new transdisciplinary experience.

Baders, Endijs

The structure of semi-natural un-even aged Norway spruce stands in hemiboreal zone: A case study in windthrow area in Slitere National Park, Latvia

Endijs Baders, Aris Jansons, Karlis Taukacs, Agris Pobiarzens, Juris Katrevics

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Natural disturbances are one of the main driving forces that alter forest structure and increase its diversity. However, due to continuous management in hemiboreal zone in Europe unmanaged and uneven-aged Norway spruce stands are rare. Knowledge of the structure of such stands can be useful for management of nature protection areas and development of principles of close-to-nature forestry at a landscape scale. The aim of the study was to assess this structure in unmanaged forest stands formed after large-scale stand-replacing disturbance. Dimensions of all standing trees (DBH > 6.1 cm) were measured in 17 circular sample plots (500 m^2) in compartments selected randomly from stands severely affected by the storm in 1969 and not managed after this event. Stands were located in two forest types: *Myrtilloso-sphagnosa* and *Oxalidosa* (OX). The basal area in unmanaged stands was significantly higher than in managed ones (data: the National Forest Inventory). Also the diameter distribution of trees differed significantly. The mean age of trees in unmanaged stands ranged from 52 to 110 years and the majority (56 %) of spruces were in advanced regeneration phase that had started after the storm.

Barbosa da Silva Lins, Daniela

Brazilian biofuels paradox: Trans-level ecosystem services trade-offs interactions of Ethanol-Cerrado complex socio-ecological system

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2 GNS Science, New Zealand

The Brazilian production of low carbon biofuels is a major driving force of direct and indirect land use change. By oscillatory behavior - especially in market demand, the emerging ethanol complex configures spatial trends of expansion/retraction of sugar cane production area. Ecosystem services trade-offs associated with the overlap of agro-energy frontier and core areas of Brazilian tropical savanna *(Cerrado biome)* create a 'carbon debt' with a long payback period. Furthermore, complex environmental and social problems generated by such interaction questioned the validity of biofuels on holistic climate change mitigation relative to fossil fuels. In this sense, the purpose of this summary is to include biofuel in ecosystem services debate, highlighting the surroundings of *Cerrado*'s fragments and, as the sugarcane industry introduces a new landscape dynamic, revealing how it affects the social and ecological processes established in the observed systems. Coping with these complex causal relationship scenarios from ecosystem services narrative requires a contextualized historical socio-ecosystemic analysis for the design of appropriate policies and decision making in order to maximize energy security, greenhouse-gas emission reduction, biodiversity conservation and sustainability of food supply.

Bastias, Cristina

The influence of canopy diversity together with biotic and abiotic factors on tree species regeneration in six contrasting European forests

Cristina C. Bastias[1], Raquel Benavides[2], Jerónimo B.B Sansevero[1], Alice G. Godoy[1], Sonia Rabasa[1], Fernando Valladares[1]

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The functional implications of a low tree species diversity that characterizes most European forests are still poorly understood, as well as its impact on the services and goods provided by these forests. One of the most important regulation services and at the same time less visible is the regeneration of the forest itself. Regeneration provides the link between current and future forests, which is crucial under current rates of environmental changes. We quantified the abundance and diversity of juveniles of different dominant tree species in mature plots, which were selected along a diversity gradient in the canopy and were in turn distributed in six contrasting European forests. At global scale, results showed a positive increase in the abundance of juveniles but contrary to our expectations, a decrease on the diversity of juveniles with species richness in the canopy. An individual analysis for each forest showed that regeneration varied according to species identity and the type of forest. There were no common trends among species to establish and survive neither in the same abiotic and biotic conditions nor under similar levels of canopy diversity. The results are still being explored to increase their potential for guiding forest management under global change scenarios.

Becker, Hardo

The effects of clear-cut on net nitrogen mineralization and nitrogen losses in a grey alder *(Alnus incana (L.) Moench)* stand

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Grey alder is a widespread tree species in the Baltic region and a promising species for short-rotation forestry. The symbiotic dinitrogen (N_2) fixation ability makes this tree important for the regulation of the nitrogen (N) cycle in forests. In a homogeneous 32-year-old natural grey alder stand (GAS) and an adjacent clear-cut (CC) in South-East Estonia (N 58° 17' E 27° 17', set up in May 2011), we analysed net nitrogen mineralization (NNM, with incubated bags), N leaching (with plate lysimeters) and N_2O fluxes (with closed chambers).The total annual NNM did not intensify in the CC area: in the upper 0-20cm soil layer the NNM was 169.9 and 157.0 kg ha^{-1} in the (GAS) and in the CC, respectively. The nitrification rate was 100% and NNM intensity was highest in July in both cases. During the snowmelt in April, the leaching of total N was up to 25 kg N $month^{-1}$ in both the GAS and in the CC site, whereas in the remaining study period it was negligible in both sites. Harvesting did not affect N_2O emission being low at both study sites (-0.55 to 19.75 and -0.77 to 7.43 kg N_2O ha^{-1} yr^{-1} in the GAS and the CC, respectively). Management of grey alder stands using traditional silvicultural methods (clear-cuts) is not likely to increase hazardous N losses trough leaching and N_2O emissions.

Blecic, Ivan

Walkability: A Measure of "Peripheriсity", and a Focus for Urban Renewal

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Everyday life exacts movements and rhythms difficult to reconcile with the form and the organisation of contemporary urban peripheries, which literally force the majority of their inhabitants to resort to cars for their movements. A possible measure of the "peripheriсity" of an urban area may therefore be its (lack of) walkability. It is no coincidence that in the urban cores (and in their ersatzes, shopping centres and the likes) pedestrian areas are prominent organising elements of the practices of use of space.To reason about walkability, we should take into account the quality of accessibility: besides the mere distance, the quality of urban space and the social practices of its use matter. Along these lines we present a methodology for evaluating walkability of places which are relevant for people's capabilities. The design and decision support system implementing the evaluation model uses actual pedestrian routes along the street network and considers their quality on the basis of several attributes important for walkability. We demonstrate possible uses of the support system by discussing a case-study assessment. We further present template examples of several lines of interventions in peripheries which gave birth to effective projects of urban renewal.

Böttcher, Hannes

Independent monitoring of GHG emissions from forest landscapes

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The land sector accounts for about a quarter of net anthropogenic GHG emissions. The reduction of deforestation and improved management of forest landscapes are especially important mitigation options. However, monitoring of GHG emissions and removals from land use remains challenging. A large number of international activities have resulted in many individual studies and additional data sources using different methodological approaches, including remote sensing. Spatial information systems need to be tailored to multiple uses relevant to varying users. It is clear that no single monitoring system will be able to supply all these functionalities. The project aims to develop a proved concept for publicly available, comprehensive, global, spatial information systems on land cover, land emissions, land use and associated trends. Monitoring systems such as Global Forest Watch have so far been mostly supply-driven (technical potential). We assess data requirements from the demand side. We will present first results of the assessment of existing systems, user needs in case studies that will improve efficiency and effectiveness of monitoring systems, and their ability and flexibility to provide services to different users, including co-benefits such as biodiversity.

Castel-Branco, Cristina

A Geodesign workshop for participative planning within the Lisbon Metropolitan Area

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This article describes Carl Steinitz's "Framework for Geodesign" (2012) application to the Tagus River Estuary in an intensive International Geodesign Workshop (2014), as part of Portugal's Landscape Architecture and Urban Ecology PhD program. The study addressed both highly complex territorial issues, and the Tagus estuary as a cultural landscape for potential listing as a UNESCO World Heritage Site. The Tagus estuary consists of 32,500 hectares of tidal area, surrounded by 7 municipalities containing more than two million inhabitants. Industrialization has left many contaminated areas, but the upper estuary has survived as a biodiversity haven. Steinitz's framework proceeds in three iterations of six steps, each defining a type of model: 1. Representation; 2. Process; 3. Evaluation; 4. Change; 5. Impact; and 6. Decision. Key territorial issues were identified. All graphics were hand drawn on transparent plastic sheets. Eight teams developed evaluation maps for each of the issues and created related policies and projects (change models). Then new teams were formed to represent six interest groups. Each prepared a design by selecting among projects and policies, and creating new ones as needed. Each design was evaluated and revised. Techniques for achieving consensus were explored to create a single design for the region.

Cateau, Eugénie

Litter beetles are indicators of ancient and current forest ratio

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Saproxylic litter beetles, especially flightless ones, are indicators of temporal continuity of forest, which is an important element of biodiversity conservation in landscape management. However, little work has been done in comparing the importance of local and landscape-scale historical factors to explain species pattern. In this study, a set of historical, internal and landscape factors was investigated in forest litter beetle communities in a region with highly fragmented forests (Coteaux de Gascogne, SW France). We sampled 27 woodlots, divided in 9 triplets (ancient >10ha, ancient <3ha, recent <3ha), in three different subregions. We extracted past and present spatial patterns of the woodlots from old maps and aerial photographs. In each forest, 10 trees were sampled by litter sieving and beetles were extracted through the Berlese device. At the community level, geographical subregion, ancient and current forest ratios were the most explanatory variables in Correspondence Analysis. At the species level, 5 were indicators of ancient forest ratios and 4 of current ones. Compared to other species, flightless beetles turned out to be a better indicator of ancient forest ratio. Those results showed that the history of surrounding forest was more important for litter beetle than forest ancientness.

Colville, David

Using a Landscape Modeling Framework to Assess White-tailed Deer Special Management Practices in Nova Scotia, Canada

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A key factor in the life strategy of White-tailed Deer, Odocoileus virginianus, is to congregate in large, high density groups during winter in mature or mixed softwood stands which offer cover as well as access to acceptable browse. Deer exhibit fidelity to both their winter and summer ranges and this is thought to be a learned social behavior transmitted from does to fawns over successive generations. Elimination of a traditional deer wintering area (DWA) may have serious detrimental effects on deer accustomed to migrating to a particular area. The Nova Scotia Department of Natural Resources (NSDNR) in 2012 established as policy a Special Management Practices for forest harvesting on Crown land in traditional DWAs identified in the Department's Significant Habitat Data Base. Developed from published information, the efficacy of this SMP was examined with NSDNR's GIS-based Landscape Modelling Framework (LFM) using mid-1990s deer telemetry data from a critical DWA in southern Cape Breton. The Cape Breton landscape metrics were then compared to conditions in the concurrent and extensive St. Mary's River DWA, and to existing conditions in both DWAs. The results of this landscape management approach are being used to support wildlife and forest management.

Dawson, Lucas

Identifying institutional drivers of change in landscapes using participatory modelling methods

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Social-ecological systems are complex. Successful planning and management regimes for such systems must be devised using a framework that can explain this complexity and provide practitioners with tools for engaging with it. Systems thinking may provide such a framework. We are conducting ongoing research into adaptive governance strategies for the planning and management of multi-functional green infrastructure using participatory systems modelling methods, including causality mapping, quantitative modelling, and scenario development. Initial studies in Sweden identify a number of key system drivers of short-, medium- and long-term social-ecological system functionality. The general transferability of these drivers to similar ecological contexts is the focus of the current research, which will see in the study reproduced along West/East and Urban/Rural gradients in the Baltic Sea Region. Comparative studies will reveal the extent to which various governance strategies for green infrastructure may either be generally applicable or be otherwise context-bound within specific institutional constraints.

De la Barrera, Francisco

Perception and quantification of ecosystems services provided by a peri-urban natural reserve of Santiago de Chile

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Urban expansion in Latin-American cities can be faster than urban planning. Indeed, some countries have neoliberal policies that promote private initiatives and restrict public control. After analyzing the types of peripheries in Santiago we decided to research a privately owned land rich in biodiversity embedded in the fringe of the city: the Panul reserve. The particularity of the Reserve is related to the emerging conflict between the private interest of developing the site and the conservation of the area. Existing planning tools are unable to protect the reserve; however, social movements and scientific research about the risk to nature and the existence of endangered species have forced a reconsideration of the reserve development. In order to support this consideration, we evaluate the multi-functionality of the reserve through the quantification of two ecosystem services (ES): recreation through a survey performed among 60 residents, and local climate regulation through air temperature measurements. The reserve shows the potential to increase urban green spaces, where inhabitants recognize and appreciate the ES supplied, and plays a significant role in mitigating the urban heat island during summer nights. ES have emerged as a concept and framework to evaluate competing urban development alternatives.

De Smedt, Pallieter

Woodlice and millipedes in small forest fragments in Europe: Possible implications for litter decomposition

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Arthropods play a crucial role in the decomposition of organic matter. Soil macrofauna, such as wood lice, earthworms and millipedes, represent the first step in the process of litter decomposition on forest floors. They reduce large particles to smaller sizes and are therefore functionally important regarding nutrient cycling. In this study we focus on the distribution of woodlice and millipedes in the forest interior and edges of small forest fragments in agricultural landscapes. Arthropods were sampled using pitfalls in 224 deciduous forest fragments in 7 regions across Europe from south France to central Sweden. Woodlice and millipedes show different patterns and respond in a different way to forest edges. Woodlice were far more abundant in forest edges compared to interiors. This pattern was less clear for millipedes. Also the intensification of the surrounding landscape influences the species composition and numbers, with more individuals in more intensively used landscapes. These relatively immobile species groups tend to be strong indicators for the age but less for the size of forest fragments. The differences in species composition and numbers of these important detritivores inhabiting forest patches and landscapes, is discussed with respect to litter decomposition.

Deconchat, Marc

Roles of forest edges in landscape agroecology

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Forest edges are the result of local sparing of agriculture and forest land uses, but their ecological interactions are strong and need a better understanding in the perspective of an agroecologically-oriented land management. Our presentation explains, on the basis of literature and the results of several projects, how forest edges can be used to improve the ecosystem services' benefits to agriculture. Most of these services are based on flows of individuals and matter. We present the synthesis of pest regulation and pollination services (most frequently studied services in relation to forest edges) and micro-climate and water regulations. Production services (wood and non-wood items) are potentially important for developing new activities on farms. Interactions between animal breeding and wild animals are also a growing concern, especially regarding their health. From our analysis, we draw new directions for future research. The variability of forest edges appears to be an underestimated factor that needs to be better understood. The social dimension of forest edges, where two actors often interact, is also a key point to take into account for better management and improvement of ecosystem services.

Dezécache, Camille

Deforestation in tropical forested landscapes: Disentangling pure spatial contagion from socio-economic drivers in French Guiana

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The Guiana Shield remains one of the largest unfragmented tropical forest landscapes. However, associated ecosystem services (carbon, biodiversity, water supply) are now under pressure. In French Guiana, population will double within 20 years, agriculture might expand as a response to local food demand, and gold mining is rising rapidly. Using GRASS/R and random forest classifier, we show that contagion is the main predictor of the location of deforestation. Protected areas effectively contribute to preserving recreational areas within the cities but suffer from uncontrolled expansion of illegal gold mining elsewhere. However, making a clear distinction between geographic factors influencing the spatial probability of deforestation and socio-economic factors determining its intensity, we prove that deforestation trends in the long run depend critically on the underlying socio-economic processes occurring inside a given area. As such, the identification of these processes is an important issue to provide relevant tools for decision making. More specifically, in urban and agricultural human-modified landscapes, economic incentives and urban management policies are key predictors of deforestation intensity, helping to mitigate the effect of demographic pressure on deforestation rates.

Dhar, Amalesh

Mapping the impact of mountain pine beetle outbreaks on forest ecosystem services in British Columbia, Canada

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Outbreaks of mountain pine beetle (MPB) are natural phenomena that play a critical role in the development, senescence, and rebirth of pine forests in Canada. However, the current MPB outbreak has impacted a record >18.5 million hectares of pine forests in Western Canada, placing forest values at risk and threatening socio-cultural stability as well as the long-term economic well-being of the communities within the regions. To determine the social, economic and ecological impact of the MPB outbreak, an ecosystem service (ES) based approach was applied. Based on land cover information and monitoring data, several ES were assessed and mapped for the MPB affected areas. The results reveal that timber is the most impacted provisioning ES although some stands do retain >100 m3/ha timber after MPB attack. Hydrology is the most affected regulating service, with peak stream flow being positively correlated with mortality percent. The effect on carbon storage was comparatively less due to the accelerated growth of residual trees and presence of regeneration in most of the impacted areas. Habitat services showed mostly positive effects. The ongoing assessment will also assess MPB impacts on recreation services and identify the most vulnerable ecosystems to MPB for predicted areas of spread.

Donis, Janis

Differences in forest spatial pattern depending on data source and pixel size used: Case study Latvia

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Landscape pattern is one of the indicators used in forest management sustainability assessment within the Forest Europe framework. The results depend to some degree on the used pixel size as well as the source of information. Most easily available data source is the Forest State register (FSR) maintained by the State Forest Service; unfortunately it includes no information about forests on overgrown former agricultural lands neither does it include non-inventoried forests. We used data from ten 100 km^2 quadrants: FSR forest polygons, data from orthophoto images with 0.5*0.5m pixel size. We used non-supervised and supervised classification in ENVI5.0, manually digitised areas which fit forest definition in ArcMap 10.1. Then forest pixels were reclassified to 5m, 10m, 20m, 25m, 30m, 100m size. Landscape pattern classes were calculated using Guidos 1.4, but connectivity was calculated using Conefor 2.6. We established that about 5% of forests are not included in the FSR. Forest area in landscape is reducing from 43.2 to 42.4% with increasing pixel size from 5m to 100m. At the same time, if source data are equal, with increased pixel size the core area is increasing. When additionally digitised polygons were used, the ECA (equivalent connected area) on average increased by 17% in comparison to FSR data alone.

Donis, Janis

Recent forest fire history in Latvia: The last 90 years

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Most forest fires in Latvia are human initiated. The goals of the present research were (1) to assess spatial and temporal distribution of fires 2) to assess the actual relationships between the number of wildfires and stand types (forest fuel type (FFT)), depending on weather conditions. Historical wildfire data were searched for in literature and archives, while most recent data were received from the State Forest Service. Weather data were obtained from the Latvian Environment, Geology and Meteorology Centre. During the last 90 years there were on average 628 wildfires per year (min 150, max 1929). The number of fires is increasing. Mean area of forest fires is 1,014 ha per year (min 37, max 12, 013 ha). In both analysed periods (1975-1984) and (2004-2013) for which we have district level data, most fires took place in the vicinity of the largest cities – Riga and Daugavpils. We analysed the relationship between the number of fires and weather conditions characterised by the Nesterov index (NI), for the period 2007 - 2011. During the analysed period 50 days were with very high fire danger index and 205 - 250 days with high fire danger index. During these days 65-75% of registered fires took place. The highest probability of fire emergence was during average or high NI periods in stands of high fire danger classes.

Drobnik, Thomas

OPSOL: Operationalizing cross-scale interactions of soil functions, soil use, spatial development and land management spatially explicit in a decision support system

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Soil is one of our most precious resources, on par with water and air. Still, spatial planning often treats soil as a mere surface. Our interdisciplinary project OPSOL aims at linking knowledge on soil functions and their services, agro-economic land-management and settlement expansion to the policy context and substantive laws. Results might serve as decision-support when assessing policies designed to support land-use patterns preserving ecosystem service potentials. In this contribution, we present first results of our modelling framework. After a short introduction, we continue with an overview of the modelling framework and present how we integrate ecosystem services and dynamic settlement expansion into an economic land-use allocation model. We then apply the modelling framework to a case study area in the Canton of Valais, Switzerland. The results of multiple model runs indicate that altered spatial planning directives: 1) could improve the preservation of ecosystem services and 2) do not impose significant financial burdens on the primary sector. We conclude with insights from a workshop with local stakeholders, where we used the modelling framework to feed a decision support platform.

Duflot, Rémi

Combining habitat suitability modelling and spatial graph for multi-species landscape conservation planning: A case study in south-eastern France

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Landscape connectivity plays an important role in biodiversity conservation. Hence, the maintenance of ecological networks has been promoted in conservation planning from continental to local spatial scales. We propose a methodological framework combining habitat suitability and spatial graph modelling to identify and prioritize areas that contribute to ecological networks at meso-scale. Within a 200km² study area, located in south-eastern France, we collected environmental data (topography, land cover and vegetation type) and recorded bird, plant and butterfly species in 160 plots. For each taxonomic group, we selected a set of species with different ecological requirements and dispersal capacities. For each species, we used MaxEnt to model the ecological niche and the presence probability map over the whole study area. From these maps, we (i) identified suitable habitat patches and (ii) estimated landscape resistance to species movements. Then, spatial graphs were built in Conefor using habitat patches as nodes and least-cost paths derived from landscape resistances as links between these nodes. The contribution of each node and link to habitat network connectivity was estimated. Finally, all species graphs were combined to generate a multi-species ecological network diagnosis.

Echeverría, Cristian

Spatio-temporal changes in the provision of multiple forest ecosystem services in a deeply threatened temperate landscape in southern Chile

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Forest ecosystems have exhibited progressive loss and degradation due to land use change (LUC) around the world. Therefore, we aimed at finding out how the provision of forest-related ecosystem services (FES) varies over time and how space enhances our understanding about forest management. In this study we examine to what extent changes in forest cover can affect the provision of FES such as timber and NTFPs. We applied a spatially explicit approach along with field surveys to identify and map FES. We found that old-growth temperate forest was the predominant land cover in 52% of landscape in 1985. All types of land cover affected by human activity, such as disturbed forest, shrubland and pastureland, exhibited the highest increase in area over time. Timber stock declined 70% between 1976 and 2007 across the landscape. The highest stocks (597m3/ha) and flows (20m3/ha/year) of timber were found in old-growth forests occurring in remnants of forest fragments. The distribution of NTFPs was positively correlated to disturbed forests and shrubland. We conclude that new approaches of forest management that balance the provision of multiple FES should be considered, especially in natural landscapes threatened by uncontrolled human-induced LUC.

Ehrmann, Steffen

The influence of patch-, landscape and climate related variables on tick abundances and tick-borne disease in deciduous forest patches

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It is assumed that landscape fragmentation is a driving force behind increasing occurence of tick-borne diseases. To test if those diseases depend on patch and landscape metrics, data on tree structure and understory vegetation as well as on ticks were collected in 256 forest patches across Europe. Eight study sites were established from Estonia to southern France and each study site included two landscape windows distinguished by their landuse intensity and heterogeneity. Each window of 5 km x 5 km was chosen so that at least 16 deciduous forest patches of varying size and age were included. Additional variables on climate, landscape configuration, land use, and plant functional traits were gathered from databases. Principal component analysis and mixed models were applied to the data. It is hypothesized that (1) tick counts and prevalence of Lyme disease depend on edge-density and perimeter/size-ratio of small deciduous forest patches, that (2) tick counts depend on herb-layer configuration (habitat), microclimate and light availability (drought stress) but are not affected by site productivity or plant functional traits and that (3) tick-borne encephalitis is not affected by patch and landscape-related variables. First results show that these effects exist under certain conditions.

Elbakidze, Marine

Cross-sectoral place-based integrated spatial planning for functional green infrastructure in the Baltic Sea Region

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The EU Strategy for the Baltic Sea Region (EUSBSR) highlights the need for reconciling economic, environmental and social objectives through the leading political principle of sustainable development. There is an urgent need to establish a transnational dialogue platform for evidence-based collaborative learning among stakeholders for practical solutions towards functional green infrastructures. This process has begun among academic and non-academic actors from Belarus, Russia, Latvia, Sweden and Ukraine. The partnership focuses on application of evidence-based knowledge for integrated spatial planning towards ecological sustainability in the Baltic Sea Region, increasing the knowledge about place-based integrated spatial planning for functional green infrastructure among municipal and land use planners, local and regional stakeholders, researchers, postgraduate students, and other involved parties, enhancing public and political awareness and offering educational ideas about how to act in practice towards functional green infrastructures. This partnership is a foundation for long-lasting action-oriented collaborative learning among stakeholders at local and regional levels of governance and among Baltic Sea Region countries.

Elbakidze, Marine

How to bridge barriers for knowledge production and learning?

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There are multiple challenges regarding the use and governance of landscapes' goods, functions and intangible values for ecosystem health and human well-being. One group of challenges is to measure and assess all sustainability dimensions through performance targets, so stakeholders have transparent information about trends and states. Another group is to develop adaptive governance at multiple levels, and management of larger geographical areas across scales. A framework for transdisciplinary research using multiple landscapes as place-based case studies that integrates multiple research disciplines and non-academic actors is presented. The framework includes 7 steps: (1) identification of a suite of landscapes, and for each (2) reviewing landscape history, (3) mapping stakeholders, use and non-use values, products and land use, (4) analyzing institutions, policies and the system of governance, (5) measuring ecological, economic, social and cultural sustainability, (6) assessing sustainability dimensions and governance, and finally (7) making comparisons and synthesizing. Collaboration, communication and dissemination are thus core features. Analysing experiences of funding application processes, project initiation and implementation, we discuss bridges and barriers for applying this approach.

Evans, Paul

Dynamics of Ecosystem Services in Forest Ecosystems

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Ecosystem services (ES) are the products of functioning ecosystems and so provide a convenient metric by which to test ecosystem functionality. Forests provide the greatest multi-functionality of any habitat, making them particularly important for ES provisions. However, environmental change and anthropogenic stressors are decreasing the condition of forests globally, inevitably reducing their functionality. Ecological thresholds and abrupt regime shifts are critical to identifying the resilience of ecosystems. While evidence exists for thresholds in aquatic ecosystems, prospects of them in terrestrial ecosystems are still largely theoretical, but would have major implications upon forest functions at the landscape and regional scales. To test whether thresholds exist in ES provisions and ecosystem functions as forests become increasingly degraded (termed forest collapse), various ES were measured over a gradient of collapse in the New Forest, UK - woodland that is currently undergoing major decline. Using replicated plots of different stages of forest collapse, relationships between various ES and collapse were measured. Preliminary results suggest that thresholds can be identified in some ES provisions, indicating that ES decrease more rapidly past a certain point.

Fan, Peilei

Planning green infrastructure in new urban periphery: The case of Shanghai

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Green infrastructure has been increasingly recognized in sustainable planning worldwide. In China, the amount of green space per capita is considered as an important measure by policy makers due to its potential role in regulating air quality. Our objective here is to understand the changes in green infrastructure and its socio-economic implications by focusing on new urban periphery of Shanghai, the largest city in China that has experienced a rapid change in its landscape and environment in the past three decades. We first evaluated the new urban periphery areas that have been added to Shanghai from 1978 to 2010 and characterized the landscape of this new urban periphery area. We then compared the patch pattern and changes of the green infrastructure within the new urban periphery, especially between the inner and outer suburbs. We quantified the accessibility of Shanghai's green infrastructure by calculating the distance and access time to the nearest green infrastructure. We also examined the role of planning and its effectiveness in driving the expansion of urban periphery and determining the spatial patterns of green infrastructure by comparing the green infrastructure planned in Shanghai's master plans in different years and the evolving green infrastructure in reality.

Foderi, Cristiano

Wildfire ignition risk modeling in Aosta Valley: Natural and anthropogenic components interactions analysis

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Fire has been burning ecosystems for millions of years, helping to shape global biome distribution. Although usually treated as a disturbance, fire differs in that it feeds on complex organic molecules as herbivores do. In this work we used probability risk models of wildfire ignition based on the maximum entropy algorithm, commonly applied in species distribution models. The risk model has been implemented for the ignitions database of the Aosta Valley Region, analyzed according to season and vegetation type patterns. Predictors considered for characterizing ignitions were selected to represent morphology, climate and land use of the area; distances from buildings and roads were considered to evaluate anthropogenic components. In addition, to investigate the relationship between ignition and socio-economic reality of the territory, the number of grazing animals (and farms with grazing animals) was taken into account.To reduce errors caused by multicollinearity of environmental predictors, a principal components analysis (PCA) was conducted. The models were produced, using 70% of dataset's points and validated, using the remaining 30% as an independent test, selected by 5 bootstrap replicates. The predictors were analyzed with a JRR procedure for measuring individual contribution to model's accuracy.

Fracassi, Natalia

Identifying connectivity corridors for marsh deer in a landscape dominated by afforestations in the delta of the Paraná River, Argentina

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The delta of the Paraná River is one of the most important wetlands of South America. The final portion of the lower delta represents both the southernmost stronghold for the marsh deer (Blastocerus dichotomus) and most extensive commercial plantations of Salicaceae (Poplar and Willow) in Argentina. To improve field conditions for developing plantations, infrastructure systems such as polders or water management methods like drainage of freshwater marshlands, are implemented and they affect marsh deer habitat. As a result, the regional metapopulation of this ungulate comprises three poorly-connected subpopulations, inhabiting large tracts of plantations with non-intensive management or well preserved patches. To obtain quantitative data for guiding conservation planning and forest management for improving landscape connectivity for deer, we collected records of the species in the lower delta (n =91) through camera-trap survey and interviews with local producers. We developed a regional connectivity network for deer by combining a habitat suitability model with Dijkstra's shortest path algorithm through UNICOR. Our results showed at least three specific areas where efforts to increase habitat connectivity among subpopulations through good forestry practices or new reserves should be prioritized.

Frank, Susanne

Including temporal and spatial scales in ecosystem service assessment - combining modelling approaches and data at different scales

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Latitudinal and altitudinal distribution of vegetative zones was described by Alexander von Humboldt in the early 19th century. Since then, relations between ecosystems, altitude and latitude were studied in scale-dependency. To this day, landscape ecology has become much more complex. Besides the spatial scale, further characteristics are relevant for investigating processes, functions, and services obtained from landscapes. In order to understand the generation and provision of ecosystem services, also temporal aspects are of central importance. We present how scale-dependency is handled in the landscape change simulation software GISCAME. The integrated assessment of ecosystem services requires the consideration of several scale dimensions. Grain size and map extent are well-matched to the regional scale. Such processes as landscape fragmentation and habitat connectivity are addressed with the help of a landscape structural assessment approach. The temporal dimension is currently taken into account in 5-year-steps. To integrate also local processes, the results of local growth and yield models, for example, were implemented and upscaled. Such an integrative landscape assessment approach supports understanding the complex landscape system and its reaction on land use change.

Frank, Susanne

Forest management and its effects on ecosystem services provision at the landscape scale

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Sustainable forest management requires the consideration of the whole landscape. Economic and ecological planning targets must be addressed in the context of other land uses. In this contribution, a procedure is presented, which implements sectoral planning strategies into regional planning processes. The integrated modelling platform GISCAME enables upscaling sectoral management strategies to the landscape level. It reflects temporal dynamics in changing forest landscapes. Such silvicultural management strategies can be simulated which target for increasing yield, enhancement of fuel wood provision, or other woody biomass related targets. As a second step, such sectoral strategies are implemented into regional ecosystem services assessment. Besides ecological integrity, provisioning services, cultural service and regulating services are considered. Additionally, structural aspects of landscape are taken into account. It is possible to analyse the impact of landscape fragmentation, habitat connectivity, and landscape diversity on ecological integrity. For successful development of management strategies, it is recommended to involve stakeholders from different scales and disciplines (foresters, forest managers, regional planners) in a participatory planning process.

Frelich, Lee

Disturbances of many types and sizes impact the boreal to temperate forest transition in a warming climate

Lee Frelich

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The temperate-boreal ecotone in the western Great Lakes region of Minnesota, Wisconsin and Michigan, USA, comprises a mosaic of boreal, temperate and mixed stands several hundred km in width. Recent climate warming has allowed temperate tree species to start invading boreal stands at local and regional scales with spatial variability due to many types of disturbance. Treefall gaps lead to gradual transition within stands as advanced regeneration of temperate maple is released from suppression. Large windstorms cause similar release at scales of 100s to 1000s of km^2. Fires in intact or post-windthrow forests also provide opportunities for species adapted to warmer environments to reproduce. Deer and moose densities have high spatial variability caused by variability in predator density (wolves) and human changes to the landscape, and cause patchy delay in transition across the landscape by preferentially eating seedlings and saplings of temperate maple and oak rather than boreal spruce and fir. Spatially variable disturbance to the forest floor by European earthworms interacts with fires, windstorms and earthworms. The net result is a highly variable mosaic of transition from boreal to temperate forest with novel species composition due to the novel filters on species success.

Fürst, Christine

How to make use of the concept of ecosystem services to better integrate spatial planning and impact assessment processes - the GISCAME platform

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With this contribution, we will present a conceptual framework on how to make use of the CICES cascade from ecosystem processes and structures over ecosystem services towards benefits for human well-being, in order to better connect the spatial planning and impact assessment processes. As an example of how to realize the suggested framework, we will introduce the software platform GISCAME that was developed to support land use planning, ecosystem services based impact assessment and decision making at different scales. GISCAME supports comparative analyses of combined land use and land management change scenarios. The software platform enables a temporally highly resolved and spatially explicit mapping and assessment of the ecosystem services provision and includes ecological analyses through landscape indicators that are principally relevant for biodiversity management at the mesoscale. We will demonstrate the functioning of the software by selected examples and will conclude by showing how integrative modelling platforms such as GISCAME should be further evolved and how they can be successfully implemented in practice.

Gastón, Aitor

Species' use of the landscape inferred from environmental variables at multiple scales: How much we gain from high-resolution data?

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Spatial resolution of environmental data may influence the results of habitat selection models. As high-resolution data are usually expensive, an assessment of their contribution to the reliability of habitat selection models should be of interest for both researchers and managers. We tackle this question by making use of a large dataset of about 8,000 brown bear presence records in the Cantabrian Range (NW Spain) where the last native bear populations in the Iberian Peninsula remain. We evaluate how different data on forest cover influence the inferences and predictive power of multi-scale habitat selection models for brown bears. We quantify the relative performance of three types of data on forest cover: (i) coarse resolution data from Corine Land Cover (minimum mapping unit of 25 ha), (ii) medium resolution data from the Spanish Forest Map (minimum mapping unit of 2.5 ha and more detailed information on forest composition and structure), and (iii) high-resolution Lidar data (about 0.5 points/m^2), providing much finer information on forest canopy cover and height. We discuss the reasons that may affect the added value of high-resolution data for explaining habitat selection by forest species, particularly those with broad spatial requirements like brown bears.

Gebel, Micha

WebGIS based simulation of land use impacts on hydrological ecosystem services in two coastal study areas of Western Cape (South Africa)

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A particular objective in the project SPACES-GSI is the assessment of surface water and groundwater vulnerability with respect to land use as well as the implementation of a mesoscale model for simulating runoff, soil loss, and nutrient leaching in two coastal study areas in Western Cape Province. Increased pressure on water resources is caused by ongoing population growth, increasing land use intensity and land cover changes since the political turnaround in 1994. A big issue for water resources management is to reduce eutrophication and sedimentation, which are especially relevant for the highly protected and vulnerable ecosystems like wetlands and Fynbos areas along the coastline. The simulated runoff shows a large regional variability, caused by big differences in the distribution of rainfall. Critical source areas for direct runoff, soil loss, and sediment input are closely connected. Treated waste water (as well as untreated flushings) is mainly responsible for the dissolved phosphorus input. Nitrogen derives mostly from agriculture. In the next step impacts of land use change on water resources will be simulated and provided by a Web-based information system to support stakeholders with information for decision making in the field of water resources management.

Geneletti, Davide

Sustainable planning approaches for new urban peripheries: A review

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New urban peripheries (NUP) keep growing worldwide with different intensity and characteristics, which are dependent on local territorial and socio-economic conditions. In general, two main processes of growth can be identified: i) by adding new urban agglomerations far from existing poles, and ii) by the "peripheralization" of areas, following changes in economic and social conditions. Innovative planning approaches are required to achieve a sustainable growth of NUP. This contribution reviews the application of current sustainable planning approaches in different NUP contexts, with the objectives of advancing the understanding of how these approaches are applied to promote sustainability, to improve stakeholders' involvements and to support policy, planning and management. The considered sustainable planning approaches include Ecosystem Services, Adaptive and Evidence Based Planning, Geodesign, Green Infrastructure, Participatory Planning, which appear to be promising approaches in different contexts and at different scales. The results of the review will be presented by discussing the following main questions: To what extent have existing planning approaches proved to be effective in NUP? What are the key limitations to make these approaches actionable, and how to overcome them?

Geneletti, Davide

A method to support the design of ecosystem-based climate adaptation measures in urban area

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We present a methodology to improve the provisioning of climate regulation services in urban areas through Ecosystem-based Adaptation (EbA) measures, and the expected benefits on different population groups. The methodology is based on the assessment and design of EbA measures focused on their local climate regulation performance. Preliminary results provide a spatially-explicit classification of the cooling effect of green/blue areas in the city, and investigate the relationships between the attributes of an ecosystem, the spatial extent of the cooling effect, and the ultimate effects on beneficiaries. The considered attributes include soil cover, tree canopy coverage, size and shape. Specifically, we address two research questions i) which attributes of green/blue areas affect the provision of climate-related ecosystem services, ii) which combinations of attributes enhance the overall performance. Insights about the most effective solutions for improving climate adaptation through EbA are provided and discussed with respect to specific planning interventions. The methodology has been applied to different urban contexts in Europe.

Giffard, Brice

More slug-predator Carabid beetles at the edge of forest fragments than in their interior

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Slugs are an increasingly serious problem for many crops in Europe. Thus, there is a growing interest concerning the service of regulation of these populations which can be provided by Carabids. As these species are known to be present in forest, the question arises if there is a flow of these carabids from the forest fragments towards the crops, where they could help to control slug populations. This flow was evaluated thanks to directed pitfall traps which separated individuals according to their direction of movement. The traps were installed in the interior and at the edge of 220 forest fragments, old and recent, distributed among two types of landscape (bocage and open field) in eight regions of Europe (from the south of France to central Sweden). The results showed higher abundances at the edges than in the interior of forest fragments. The differences were more marked in the open field landscapes, where abundances were higher than in bocage landscapes. They were also higher in old as compared to recent forest fragments. The distribution of abundance of Carabid species let us suppose the possibility of a flow from the interior towards the edge. Monitoring of individual movements would be necessary to validate this hypothesis.

Gonçalves, Artur

Urban Green Spaces diversity and their added value to urban sustainability: A case study from Bragança (Portugal)

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Urban green spaces (UGS) combine a wide range of elements that offer diverse ecosystem services, such elements are often measured in a single general category without valuing diversity. This study carried out in Bragança (Portugal), a small town with a population of around 25,000 inhabitants, uses spatial metrics (ArcGis 9.3 - ESRI ® - software) to identify and measure characteristics of local UGS, applying a framework for its classification and addressing its attributes, including their ownership, access, vegetation, relation with biophysical context, cultural value and urban planning determinations. Further information, related to the social relation with the UGS was also gathered with questionnaires to 251 inhabitants, addressing a representative sample (proportional to gender and age groups), and taking into account the spatial distribution of the population. The results show that many of the UGS are not developed to ensure an adequate response to social demands (eg. recreational needs) and even offer little interest from the perspectives of urban resiliency and sustainability. Finally, it is argued that UGS should be addressed considering the urban green infrastructure perspective and should be carefully planned to ensure that they have a valuable impact on urban life quality.

Gosal, Arjan

The Understated Value of Natural Historic Landscapes: Valuation through Spatial Analysis of Ecosystem Services

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The Millennium Ecosystem Assessment highlighted the importance of quantifying ecosystem services as being pivotal to the allocation of environmental resources. Whilst biophysical and economic values are often used in management and conservation planning decision making, community ecosystem values are rarely quantified or defined clearly. Recreation, aesthetics and cultural ecosystem services are primary in this study. Various techniques, including participatory GIS, spatial mapping, and existing data sets are explored in relation to the New Forest. Situated on the South Coast of England, it is a prime example of a historic natural landscape, from being a medieval hunting ground to a commoning system that survives to the current day. England's most recently designated national park has over 34,000 residents and many more visitors each year. With a clear need to understand the dynamics of how people value the various habitats and areas of this national park, this study aims to inform future management decisions made by the managing authority through a robust and adaptable methodology. Results from stakeholder engagement, including spatial mapping of services and a multi-spatial criteria analysis of various ecosystem services for differing management strategies are presented.

Gowda, Juan

Is increasing environmental awareness adding market value to Native forests?

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During the last four decades, increasing environmental awareness has led to fundamental changes in forest legislation, management and education, as well as to increasing market regulations for forest products. Today, most countries explicitly include sustainable management and conservation in forest practices, forestry faculties have modified their curricula to adapt to this new demand from society, and non-governmental certification systems such as FSC are required for tropical forest products entering Europe and North America as well as for investment portfolios that include any tropical forest. Parallel to this trend, forest investments in emerging countries target forest plantations, whereas native forest management is increasingly difficult to fund. In this presentation, I explore some examples of current investments in native forests to evaluate whether the perceived environmental value of native forests is related to their market value. I propose that in emerging countries increasing awareness of the environmental services provided by native forests may often lead to a reduction of their market value; I also present some ideas on how to change this trend and open a general discussion regarding the role of researchers in this process.

Guitet, Stéphane

Geomorphological landscapes are key-factors for predicting spatial variation of ecosystem services in undisturbed tropical rainforest

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Tropical rainforests exhibit a high alpha-diversity and a complex local structure that hides patterns at regional scale. Thus little is known about spatial distribution of tree species and variation of communities' composition at operational scales. However, this information is essential to ensure the sustainability of forest management in the local context, but also to optimize land-uses regarding to spatial variation of ecosystem services. Relying on the hypothesis that rainforest dynamics is under geomorphic control, we adopted a multi-scale framework to test the ability of various geomorphodiversity indicators to predict forest composition and changes in ecosystem services at different scales. Using large forest inventories dataset collected over French Guiana (i.e. 2,500 plots for 1,120 ha covering 80 000 km^2), we demonstrated that geomorphological landscape is the most efficient predictor of floristic patterns and forest structure, and then an important driver of large-scale carbon stock distribution as well as timber production. Comparing ecosystem services indicators at this scale also highlighted unexpected compromises between environmental functions. Such results provide key information for planning regional land-uses and guiding environment policy.

Guyot, Virginie

Higher resistance to herbivory by mixing tree species in edges rather than of forest interiors

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Tree species diversity is often acknowledged as a key factor for controlling herbivory pressure in temperate forests. However, the diversity resistance issues have been rarely studied in fragmented forests, and especially in their edges, despite the fact that these frequently occur in many temperate landscapes. We tested the effects of tree diversity (pure vs mixed neighborhood), position (edge vs interior) and their interaction on the diversity, abundance and impact of oak insects in forest fragments of landscapes in southwestern France. Overall, defoliation was lower on focal oaks in mixed (heterospecific neighbors) than in pure (only oak) stands, which is associational resistance. The magnitude of associational resistance was higher in edges, where defoliation was higher. The diversity of herbivore guilds was higher in mixed stands. However, some differences between feeding guilds were observed which might be explained by their relative abundance at stand edge or interior. The associational resistance of trees to herbivory emerged as a prevalent pattern in fragmented oak forests, with stronger effects in edges.

Hansen, Raili

Elevated humidity and meteorological conditions affect soil greenhouse gas fluxes in a young deciduous forest

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Predicted climate change will increase air temperature and affect precipitation and air humidity. Climate events (heat waves, droughts) will also be more frequent. In the Free Air Humidity Manipulation (FAHM) experiment, in which humidity can be artificially elevated, we focussed on how increased air humidity, combined with normal or extreme weather conditions and in interaction with tree species, influences soil greenhouse gas emissions (GHG). The study site is located in southeastern Estonia, on former arable land (Endogleyic Planosol) where silver birch and hybrid aspen were planted in 2006. Soil CO_2, CH_4 and N_2O fluxes were collected with the closed static chamber method and measured with gas-chromatograph during snow free periods in 2009 – 2011. Meteorological parameters were monitored on study site. During an extremely hot and dry summer humidification treatment increased CO_2 flux, but in case of normal or excessive precipitation control plots had higher or similar soil respiration than elevated humidity plots. Humidification usually decreased CH_4 consumption. More N_2O was emitted from control than humidified plots in aspen stands in summer with mean long-term precipitation. Hence, GHG depended on meteorological conditions, humidification treatment and tree species.

Hedblom, Marcus

Potential of the peri-urban landscape to meet new demands in the era of urban densification – Sweden as an example

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Northern European cities are rather extensive and have large proportions of semi-natural and natural green areas within them. In Sweden, similar to other countries, current urban policy strives to densify existing built up areas. This shifting focus, from earlier expansion into the peri-urban landscape to urbanization within city borders, has implications for the dynamics of the whole urban to rural landscape. We explore the changes in the perception and use of the peri-urban landscape by illustrating the present trends and prerequisites in Sweden, such as the common right of access to nature, and relate it to other countries. Densification and urbanization leads to reductions of ecosystem services available within cities. Thus, we envisage a future where the peri-urban landscape needs to provide a larger fraction of the ecosystem services required by urban residents. Complex questions about property and user rights need to be resolved. Long term land-use strategies of how to deal with fertile agricultural areas near cities that are turned into horse paddocks, golf courses, commuter homes or other uses, are needed. A new, more established and recognized periphery might improve ecosystem services in the city as well as outside the city by emphasizing multifunctional landscapes.

Hedblom, Marcus

Linking visual landscape preferences and biophysical data for monitoring cultural ecosystem services: Based on systematic field plot photographs

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Globally, major land-use and climate change results in altered landscapes. These changes affect the perception of landscapes, which is considered to be one of many cultural services important for human well-being. Nevertheless, the intrinsic combination of the perceived qualitative values of cultural ecosystem services and their link to quantifiable landscape attributes is vaguely studied. Moreover, there is lack in methodology of how to link landscape preferences to biophysical values over time. In this study we tested how field data, aerial and field photographs from a national monitoring program on biodiversity and land use in Sweden (NILS) can be used to monitor cultural ecosystem services. A questionnaire was sent to professionals and stakeholders related to the Swedish environmental objective “Magnificent mountain landscape”, asking them to rank photos of mountain landscapes and answer open questions related to the objective. The answers were analyzed with available biophysical values from each specific monitoring plot. Our results indicate that there is large potential in using present monitoring program to provide indicators for visual landscape preferences over time. However, there is a need to adapt present monitoring to achieve more valid and representative information.

Inkoom, Justice Nana

Approaches to ecosystem service integration into land use planning in West Africa - state of art and practical demands

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Rapid urbanization with its attendant impacts on habitat loss and landscape fragmentation poses a critical threat to the provision of ecosystem services in Sub-Saharan Africa. Further attempts by government institutions to control this mishap through land use and spatial planning schemes result in actions that affect the distribution and quality of a wide range of ecosystem services. Despite a plethora of studies undertaken in developed countries as a model for replication, principal integration remains a depth of despair. In a case study of selected West African countries, we explore through a content review, a range of decisions and strategies including the acquisition and communication of ecosystem service information for adoption into land use planning. We characterize these strategies into themes and discuss them at each stage of the integration process with emphasis on the interest of key stakeholders in the planning process. Further, we provide a cascade of varying existing objectives, targets, tools, mapping and measurement methods, challenges and practical demands, and technical expertise for transforming available ecosystem information into supporting guidelines for land use planning. The paper concludes by suggesting pragmatic actions for integrating the relevance of ecosystem service into land use planning drawing on technical guidelines.

Inostroza, Luis

Ecosystem services in urban fringes. A spatial assessment at landscape scale looking to urban planning

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Under a process of planetary urbanization, landscape urbanization overcomes current urban-rural characterizations. Nevertheless, urban fringes, the areas beyond urban cores, are providers of fundamental ecosystem services vital for urban sustainability, such as supplying commodities, offering possibilities for aesthetic enjoyment and recreation. From the point of view of urban planning, fringes provide space for future urban development. Little has been said about the provision of ecosystem services in those areas. To assess the levels of landscape urbanization and the corresponding provision of ecosystem services, a spatial characterization was developed in two regions of Upper Silesia. Several landscape indicators depicting the levels of urbanization (urbanity, urban coefficient, land use specialization and technomass) where tested. Potential provision of ecosystem services was assessed as well. The aim is to provide insights for advancing the use of ecosystem services in practical planning. Even though levels of urbanization differ in spatial structure and intensity, fringes are providers of important amounts of ecosystem services. As landscape continues urbanizing, urban fringes are highly dynamic spaces and their potential to provide crucial ecosystem services will eventually shrink.

Inostroza, Luis

South American urban peripheries: compact or sprawled? Formal or informal? A GIS spatial characterization

Luis Inostroza

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South American cities are expanding at very fast rates, reaching the average of 40 m^2 per minute. This new fast development takes place at the fringe of urban areas, in formal and informal ways, thus the process exceeds many times the planned amounts and overcomes the standard urban planning practice. Characterization of these new urban peripheries (NUPs) remains a big challenge on the continent. New tools and methods are needed for understanding NUPs before attempting feasible solutions. Furthermore, in contexts where planning is overcome, monitoring becomes an important aspect of urban governance. In this paper a set of spatial indicators is used to characterize new peripheries in a sample of South American cities. The aim is to explore specific features of NUPs on the continent by looking at specific ways urban tissue has developed in the last 20 years. The results show that NUPs possess largely differentiated characteristics depending on territorial and local socio-economic specificities.

Iverson, Louis

Tradeoffs associated with sugar maple *(Acer saccharum)* management in different parts of its US range under a changing climate

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Sugar maple provides timber and maple syrup throughout much of its range in the Midwest and Northeast US, as well as in Quebec, Canada, and sustaining these ecosystem services is of considerable interest. Besides current trends in maple decline, models project a loss of habitat throughout the century, especially in the southern portion of its range. Managers seek strategies to combat the declines, or in certain locations, admit defeat and facilitate transition, but first need tools to assess risk at various locations and under various scenarios of climate change. We devised risk matrices to quantify likelihood of habitat change at any broad-scaled location against the adaptability of the species to deal with increasing disturbances associated with climate change. The matrix elucidates risk by location (in this case Wisconsin in north central, Vermont in northeast, and Kentucky in south central portion of its range) and according to a harsh and mild scenario of climate change for periods ending in 2040, 2070, and 2100. Besides risk of decline, however, there is the socio-economic dimension of the ecosystem services as Vermont ranks first, Wisconsin ranks fourth, and Kentucky has limited maple syrup production, these are also decisive factors in future management decisions.

Joly, François-Xavier

The role of tree diversity for decomposition across European forest ecosystems

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Tree species diversity can be an important driver of ecosystem processes such as decomposition and nutrient cycling. Decomposition was shown to change in response to changing leaf litter diversity, but the relative effects of litter mixing and the diversity of tree species of the forest community are poorly understood. Using the FunDivEUROPE exploratory platform, we tested the relative importance of living tree species diversity and litter mixing for decomposition across six different forest ecosystems across Europe, using site-specific litter mixtures and two standard materials (cellulose paper/wood sticks). Preliminary results show that wood stick decomposition was not influenced by tree species richness, but decreased with increasing abundance of conifers in the canopy. Mixtures of leaf litter decomposed more slowly than expected from single species decomposition in monospecific forest plots, possibly due to less specialized decomposer communities in mixed-species plots. We conclude that favoring functional diversity in European forests will increase decomposition of recalcitrant material such as wood, but that decomposer communities may adapt to long-term input of tree species-specific leaf litter in monocultures resulting in faster decomposition than in mixtures.

Jõgiste, Kalev

Disturbance legacies of forest ecosystems: biological and physical features

Kalev Jõgiste

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The features of biological and physical legacies are determined by disturbance regime. Rationale behind the disturbance modes is based on physical and biological mechanism of ecosystem change. The detritus path of the ecosystem depends on dead organic matter. The forest ecosystem is extremely dependent on dead wood which creates both physical and biological structure. Major windstorms shape ecosystem in different ways. In the case of blowdown, besides of great amount of dead wood, the microtopography of the site is modified because of root pit-mound complexes (microsites). As an example, the windthrow area characteristics are presented from two forests in Eastern Estonia. There is a clear difference between microsites produced by hardwoods and conifer species when trees are blown down. Hardwoods are creating deep pits with advantage for species with high soil moisture requirement (e.g Alnus glutinosa). Natural regeneration of windthrow areas leads to mixed forest because of high variation in microsites. The composition of the stand is a dynamic feature due to life cycle of species and gradual change in the condition of physical and biological legacies.

Kalda, Rauno

Drivers of bat diversity in mosaic landscapes

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During the last centuries forest landscapes have gone through fragmentation and stand homogenization. Industry driven woodland degradation has had negative effect on biodiversity of many forest related taxons. However, diversity of mobile species, such as bats (that travel long distances on nightly basis), should be less related to woodland fragmentation, and respond more strongly to landscape-scale drivers and species availability in the region. Our aim was to evaluate the effect of habitat quality of a stand and its surrounding landscape on bat species richness in agricultural landscapes. We recorded bat species and their relative abundance on a gradient of habitats ranging from mature woodlands, across parks and alleys to single trees. At each point we recorded the parameters of stands and landscape. Our results show that bat species richness is mostly affected by large-scale factors such as species pool and landscape structure. Local habitat structure had the smallest effect. The conservation of bats should be based on multi-scale planning to provide optimal foraging habitat for bats; forest landscape should be diversified with integrated small waterbodies and canopy gaps with sharp edges.

Kapstein Lopez, Paula

Water courses and urban development. River banks as urban limits: The case of Rimac River (Lima, Peru)

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This presentation highlights the importance of natural water courses in the urban development and their influence in the origin of the inner peripheries in Latin-American cities. The Inner Periphery concept refers to those deteriorated urban spaces located in the city centre which in the past increased its population due to the migration process from rural areas to the cities. The relationship between natural limits and urban development is analyzed, taking into account that the formal planning instruments usually fail to solve the integration of natural borders in the urban developments. The Rimac River, whose banks constituted a peripheral borderline during the 1950s, can be nowadays recognized as an internal urban border between the central zone and the northern peripheral area of Lima. Thus, it is a paradigmatic case of Inner Periphery that reveals the importance of the connection between participatory and sustainable planning and a successful rehabilitation of this type of areas in Latin-American cities.

Kleemann, Janina

Regional differentiation in land-use patterns and its implications for integrated land-use planning in Ghana

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Population growth, spatial development, and rural out-migration have caused rapid expansion of urban centres in Ghana. The limited technical, financial and human resources and the administrative structures pose a challenge to strategic land-use planning to accommodate the unregulated patterns of population growth and spatial expansion. In this study, we focus on two regional centres Bolgatanga and Takoradi. Takoradi is located in the resource-rich Western region and serves as the economic hub for the oil industry. Bolgatanga is situated in northern Ghana where the only potential markets are small-scale mining and agriculture. We hypothesize that national strategic land-use planning favours commercial centres but neglects the economic development of structurally weak areas where processes are mostly dictated by chiefs or individual judgements, which results in uncontrolled development. In our presentation, we will demonstrate the spatial and structural differences in urban land-use planning between the prosperous south and the resource-limited north. Further, we explore how to include ecologically sensitive knowledge to inspire Ghana's current land-use planning approach, and present a scheme which harmonizes local and traditional land use strategies with national planning.

Korhonen, Lauri

Remote sensing of forest canopy cover for biodiversity studies

Lauri Korhonen

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Forest canopy cover (CC) is an important ecological descriptor variable that can be used to monitor plant and animal habitats. It is defined as the proportion of the forest floor covered by the vertical projection of tree crowns. This means that for unbiased estimation of CC, the area of interest must be covered by vertical observations of the presence of the canopy. Airborne laser scanning can provide estimates of CC that are very close to field-based values obtained this way, because the data typically covers the area of interest systematically and the view geometry is nearly vertical. Estimation of CC from optical satellite images is more difficult, because the understory and canopy reflectance can be fairly similar especially in boreal forests. However, reduced simple ratio (RSR) vegetation index incorporating the shortwave infrared band has been shown to provide improved CC estimates in boreal forests, whereas standard normalized difference vegetation index (NDVI) is reliable in other biomes. Case studies concerning the CC estimation using lidar data in Finland and optical satellite images in Finland and Laos will be presented.

Kowalska, Anna

The ability of forest ecosystems to provide goods and services in view of local community

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The aim of the study was to find out how local community perceives the ability of forest ecosystems to provide goods and services. The “door-to-door” written survey was carried out in 3 rural communes in Podlasie (North-East Poland), where forests comprise over 54% of the area. Three types of forests (deciduous, coniferous, swamp) and four other ecosystem types (grasslands, arable lands, wetlands, waters) were distinguished. Respondents were asked to assign benefits of nature to each of 7 selected ecosystem types and number the benefits in order of importance. A list of 11 categories of ecosystem goods and services was provided, including provisioning, cultural and regulating services. We wanted to find out which forest ecosystem services are recognized and valued most and what the differences between forest types are. We also compared forests with other ecosystem types. The significance of proximity from the place of residence to the considered ecosystems was also verified.

Kuusk, Joel

Hyperspectral reflectance of boreo-nemoral forests in a dry and normal summer

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Visible near infrared (VNIR) reflectance of several mature hemiboreal stands in Estonia was measured in the two consecutive years (2006 and 2007), which differed significantly in terms of precipitation. The cumulative sum of precipitation during the vegetation period of 2006 was 30-45% smaller than in 2007. The measured reflectance values were higher in the dry year for the whole study area, but broadleaved and coniferous forests reacted to changes in water supply differently: The relative change of NIR reflectance was equally about 10-15% in all stands, while the change of visible reflectance of coniferous stands exceeded that of broadleaved stands. The smallest change was observed for broadleaved stands in the red spectral region. Photochemical reflectance index (PRI), which is related to plant stress, had more negative values for broadleaved stands in the dry year, indicating higher stress level. For coniferous stands the changes of PRI values were opposite and with smaller magnitude. Previous studies have confirmed that the reflectance of a mature forest does not change with stand age. Therefore, such strong year-to-year change was unexpected. When comparing the reflectance values of the same forests from different years, possible weather-related changes must be considered.

Kuvan, Yalcin

The use of Turkey's forest resources for the purpose of ecotourism and recreation

Yalcin Kuvan, Gizem Sahin

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In today's forestry, provision of opportunities for recreation and tourism with other vital ecosystem services has gained increasing importance throughout the world. Forests as one of the main components of the natural environment are a major natural attraction for tourists and play an important role in the relationship between the environment and tourism. Both mass tourism and nature-based tourism activities require the use of protected forest areas and other forested lands for individual recreational participation as well as facility development. On the other hand, Turkey is facing increasing pressure on its natural resources from uncontrolled tourism growth aimed at achieving short-term economic benefits. The main objective of this study is to explain the main features of Turkey's forest resources used for ecotourism and recreation and to emphasize the problems that have occurred in their management. The study begins by clarifying the importance of tourism and recreation in forestry and introduces conceptual framework towards the use of forests for the purpose of ecotourism and recreation. The latter sections focus on the classification and characteristics of the country's forest resources allocated to ecotourism and recreation-related uses.

Kütt, Laura

Diversity, intensity and resilience of flower-based ecosystem services in forest edges

Laura Kütt, Jaan Liira

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The delivery and resilience of ecosystem service by plants is valued as flower reward for pollinators but is also aesthetically appreciated by humans. Regardless of great amount of research concentrated on biodiversity and various ecosystem services in intensively managed agricultural landscape, the negative trends still continue to persist. Forest edges can be important habitats facilitating heterogeneity, species richness and ecosystem service delivery in agricultural landscapes. We studied whether forest edges offer ecosystem services with the same quality as permanent grasslands. We targeted edges of old deciduous forests neighbouring crop fields and estimated service provision properties – service potential, diversity and resilience on the basis of flower colour and from the perspective of two ecosystem service groups, humans and pollinators. We hypothesize that all three service provision properties have the highest values in permanent grasslands, indicating the lower service quality potential of forest edges. Trait functionality was evaluated in terms of colour richness, flower unit size and richness as in total as well within colour group. The role of stand structure and disturbance was also evaluated.

Lang, Mait

MODIS and MERIS data based assessment of net primary production of regularly managed forests

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Forest ecosystems are important landscape elements which provide many services. The productivity of forests is an important characteristic related to climate change mitigation via carbon removal due to the removal of carbon from the atmosphere and storing it in living biomass, soil and timber. Forest productivity can be assessed by repeated inventories or a contemporary option of using space-borne measurements of absorbed photosynthetically active radiation. The applicability of Terra MODIS and Envisat MERIS data based gross and net primary production estimates in hemiboreal forests were analysed by using regular forest inventory data and disturbance maps. The alternative hypothesis of gross primary production difference between intensively managed forests and conservatively managed forests was rejected at p=0.38 with a t-test. The results show that forest management in Estonia does not decrease forest productivity.

Lang, Mait

Automated habitat mapping

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Habitats are important indicators of biodiversity and a system has now been developed to enable them to be mapped consistently in sample sites throughout Europe. Currently regional and national estimates of habitat extent are obtained from dispersed random samples based on in situ measurements located according to strata derived from environmental classifications. However, the costs of field survey are high and remote sensing offers the option of extrapolating habitat maps from the in situ sites to surrounding areas without additional field visits, therefore increasing sample size with minimal costs. The present paper describes three contrasting examples of such extrapolation using different procedures from Estonia, Wales and The Netherlands. These maps can then be used to derive regional statistics of habitat extent and subsequently for monitoring, although the latter has still to be tested. It is concluded that these examples demonstrate the potential of extrapolation to increase sample size but that the practicality still has to be tested under operational conditions.

Le Clec'h, Solen

Mapping ecosystem services at the regional scale: The contribution of an upscaling approach

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Large-scale ecosystem services (ES) mapping is a challenge for environmental management. At local scales, despite issues, there is no real gap between ES and their representation. Moreover, calibration data can be available all over a small area. At larger scales, these two previous points generate real problems, preventing large-scale ES mapping. A possible and low-cost method is the up-scaling approach, which we test on Pará State, Brazil.We mapped four ES proxies (vegetation carbon, biodiversity, soil chemical quality and soil infiltrability), locally through statistical models that link sampling (ES) and remote sensing data (Landsat, Aster) and regionally through the mean value of the proxies per MODIS land cover classes. We evaluated regional maps' accuracy through the variability of ES and through the correlations of the values at two spatial scales. Our approach provides reliable and highly correlated maps of ES that present the spatial distribution of ES at two spatial levels. Local maps take into account the specificities of the area while regional maps give an overview of ES state. Up-scaling methods complete large-scale maps by local knowledge and allow estimating maps' uncertainty; however, one cannot forget that such approaches are highly simplified.

Le Roux, Marie

Modelling the distribution and connectivity of bats in lowlands and mountain environments: A spatial operational approach towards forest conservation planning

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Today, many bats species are endangered due to modifications of their habitats by changes in land use and forestry practices. Knowledge about the ecology and behavior of many forest dwelling bats, however, remains incomplete. Bats are considered as an ecological indicator of habitat quality due to their sensitivity to human-induced ecosystem changes. Hence, we need to improve our knowledge about the characteristics and the location of bats' foraging habitats in order to plan forest management efforts oriented towards conservation. Combined spatial analyses can help in understanding the complex relationship between bats and forest habitats characteristics. Furthermore, it can be considered as an indicator proxy in decision making towards forest adaptive management. Research studies on spatial distribution of nocturnal habitat for ten bat species have been coupled with connectivity analysis based on graph theory for two species. The work was conducted in France, on two forested study areas in the lowlands and in the mountains. Then this method was replicated in other forested sites to test the operationality of the approach. The results showed that forest dwelling habitats of bats can be used to analyse landscape structure and that the latter could prove an efficient forest management tool.

Lindberg, Eva

Does detailed vegetation structure derived from airborne laser scanning (ALS) contribute to prediction of abundance and species richness of birds and beetles in boreal forest?

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In managed landscapes, conservation planning requires effective methods to identify high-biodiversity areas. Satellite images and airborne laser scanning (ALS) can provide information about vegetation over large areas. This study evaluates the potential of detailed vegetation structure derived from ALS data for predicting the stand-scale abundance and species richness of birds and beetles in a managed boreal forest landscape. Earlier results have shown that bird abundance and species richness were best explained by the ALS variables “maximum vegetation height” and “vegetation cover between 0.5 and 3 m” (both positive), while the abundance and species richness of flying beetles as well as epigaeic (i.e., ground-living) beetles were best explained by a model including the ALS variable “maximum vegetation height” (positive) and the satellite-derived variable “proportion of pine” (negative). Now we include new explanatory variables describing the size of the tree crowns and the patchiness of the canopy derived from ALS data. The results demonstrate the level of detail in vegetation structure that can be obtained from ALS data and the importance of this information compared to other variables derived from remote sensing on a coarser scale.

Lukasik, Adam

Application of soil magnetometry for assessment of spatial distribution of dust pollution in topsoil under canopy of Norway spruce *(Picea abies Karst.)* and European beech *(Fagus silvatica L.)*

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Topsoil magnetic susceptibility measurements are used as a significant indicator of air-derived pollutions containing magnetic particles and heavy metals. Trees are known as significant scavengers of air pollution that finally deposits in the topsoil under the tree canopy. Here, we focused on the role of a single tree in the distribution of dust pollution in topsoil under the tree canopy. Dense grid sampling (1m×1m) was set under Norway spruce *(Picea abies Karst.)* and European beech *(Fagus silvatica l.)* trees in two forest stands of an industrial region. The vertical distribution of volume magnetic susceptibility κ was measured in 312 soil cores (30 cm depth). Additional analyses (mass magnetic susceptibility x, pH, heavy metal contents, soil C and N) were made for selected soil samples. The results show a significant role of soil Ofh and A horizons in storage of magnetic particles and heavy metals of anthropogenic origin. Higher κ and x values were measured under beech trees where stemflow phenomenon was observed. Vertical distribution of κ values in forest topsoil horizons can be affected by natural soil processes (formation of Fe-Mn containing nodules) and animal activity (wild boar) that additionally influence the horizontal distribution of κ values.

Luque, Sandra

Forest ecosystem services and trade-offs on complex multifunctional landscapes

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Sustainable ecosystem management and well-being can be enriched with local people's perceptions. Consequently, we need innovative methods that not only facilitate shared understanding of the human-landscape relationships, but also foster collective management that can be incorporated into landscape planning processes. Likewise, when planning for ecosystem services, bundles of benefits need to be incorporated within adaptive forest management. Thus, optimization of the provision of a single service leads to reductions or losses of other services. Within these challenges in mind, we developed a Bayesian Belief Network (BBN) that integrates GIS and expert knowledge regarding two different land use interests - biodiversity conservation and timber production - with focus on a complex mountain landscape in the French Alps. The spatial models produced provided different alternatives for policy makers in order to help targeting conservation priorities and production management options. Merging different BBN models and developing multidisciplinary frameworks would improve our understanding of socio-ecological systems promoting means for efficient and effective utilization of sustainable forest management.

Löfström, Irja

Evaluation of a participatory planning process in an urban forest

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In Finland urban forests are mainly owned by municipalities. The main management goals for urban forests are securing their recreational value and the biodiversity of the areas. Participatory planning is becoming increasingly important in forest management, especially in the municipality-owned urban areas. In this study, a planning process of an urban forest area in Puijo (in the city of Kuopio) was evaluated against a set of success criteria found in literature. In addition, both the stakeholders and managers involved in the process were asked to complete a Q-sort questionnaire and rank a set of statements describing the process. The evaluation of the process documents showed that the process was successful with respect to most of the criteria used. The Q-sorts, on the other hand, revealed more critical viewpoints such as the possibility to influence the process and its outcomes, obtain access to information and provide social conditions necessary for future processes. Thus, these two evaluations complemented each other well. The results of this study can be used to further develop the process guidelines for participatory planning in urban areas.

Ma, Keming

Plant species diversity in Beijing's restored mountain forests: A multi-scale analysis

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The role of restored forests on biodiversity conservation has been extensively discussed. Previous work has found that the effect of restored forests on biodiversity is context dependent. However, no work has been conducted to test the effects of sampling scale on the conclusions pertaining to forest restoration and biodiversity. In this work, we used a multi-scale analysis scheme to test the scale dependency of forest restoration on plant species diversity. Our results showed that the forest restored by pine plantation changes multi-scale partitioning pattern of the plant species diversity. Our work found that the influence of forest restoration on plant species diversity depends on sampling scale and restoration manner. We suggest that a wide range of sampling scales should be considered in evaluating the role of restored forests on biodiversity.

Macura, Biljana

Institutions and trust in a Central Indian Tiger Reserve

Biljana Macura

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Researchers agree that local people's trust, social acceptability and positive attitudes towards agencies that govern protected areas are some of the most important factors for successful conservation. In the context of top-down exclusive conservation in human-dominated forested landscapes of India, people-park conflicts are frequent because of limited space and resources, incompatible interests, unequal power and benefit flows. In such a context, local community trust towards park management authority can be an important source of legitimacy and compliance with the park rules. This study uses household data from 16 villages located in the buffer zone of the Pench Tiger Reserve, Madhya Pradesh, India, in order to: 1) measure the level of trust towards the management authority, 2) determine predictors of trust (or lack of them). The results of the study are expected to highlight the importance of economic (benefit flow from the park, compensation for crop or cattle loss) as well as institutional (the level of social inclusiveness, local acceptance of resource access rules) context for trust building.

Magiera, Tadeusz

Screening of forest soil pollution with trace elements by using soil magnetometry

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The assessment of industrial/urban dust deposition on forest topsoil and the related threat of heavy metal pollution in many forests located around large industrial centers is a difficult task, because direct chemical analyses of pollutant content are laborious, time-consuming and expensive. The application of soil magnetometry as a geophysical method based on “in situ” measurement of magnetic susceptibility as an easily detectable parameter, and delineation of magnetic “hot spots” as tracers of forest soil pollution can solve this problem. Technogenic Magnetic Particles (TMPs), contained in industrial and urban dusts falling down on the soil surface, result in strong increase of topsoil magnetic susceptibility in areas influenced by anthropogenic dust emissions. We propose a two-stage integrated geophysical and geochemical procedure for the assessment of chemical degradation of forest soil caused by industrial and urban dust deposition. The first stage of this procedure is geophysical pre-screening based on horizontal (surface) and vertical (based on 30 cm topsoil cores) magnetic measurements that produce very sensitive 3D map of magnetic “hot spots”. The second stage is precise, targeted sampling for chemical analysis to find the exact concentration of heavy metals in “hot spot” areas.

Maltamo, Matti

Airborne laser scanning assisted inventory of ecologically valuable characteristics in conservation areas: European aspens in spruce-dominated forests

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We characterized aspen populations in a boreal nature reserve using diameter distribution, spatial pattern, and forest attributes. The data were collected from three separate stands in Koli National Park, eastern Finland. The inventory of aspens within the three stands was based on simulations with mapped field data. We mimicked stand level inventory by locating varying numbers of fixed area circular plots within the stands. Additionally, we also tested if the use of airborne laser scanning (ALS) data as auxiliary information would improve the accuracy of the stand level inventory by applying the probability proportional to size sampling to assist the selection of field plot locations. The results showed that aspens were always clustered, and the diameter distributions indicated different stand structures. The root mean square error (RMSE) of the volume and number of large aspen trees was between 25%-50% if more than 10 sample plots were measured. Stand level inventory estimates were also able to detect spatial pattern and the shape of the diameter distribution. ALS-based auxiliary information could be useful in guiding the inventory process; the improvement in RMSE was 10 % higher. However, caution should be used when applying the ALS-supported inventory technique.

Mander, Ülo

Greenhouse gas emission in full-drained peatland forests

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The long-term impact of drainage on carbon (C) and nitrogen (N) budget in boreal peatland forests has been under discussion for the last two decades. It is not clear whether the drainage-induced increase in vegetation growth and C and N assimilation will compensate losses by gas emissions and leaching. A project financed by the Estonian State Forest Management Center started In 2013. Nine research sites, 3 in each of 3 forest stands (pine, birch and spruce stands of Myrtillus and Oxalis drained swamp FSTs) on drained Histosols and Histic Gleysols in Järvselja region (Estonia) were established. Above and below ground biomass and annual production of trees and understory vegetation, litter, physical/chemical characteristics of soils and groundwater, CO_2, CH_4, N_2O and N_2 emission, and soil microbial communities are analysed on 4-plot transects perpendicular to ditches. Gaseous fluxes are measured once in 3 weeks in 4 replicates per plot.The first 1.5-year results over all the measurement sites show high soil respiration (5 – 264 mg CO_2-C m^{-2} h^{-1}), low CH_4 fluxes (from -44 to 171 µg CH_4-C m^{-2} h^{-1}), and high N_2O emission (from -1 to 147 µg N_2O-N m^{-2} h^{-1}). These amounts are respectively 80-120 times higher, 50-200 times lower and 110-150 times higher than those from initial non-drained peatlands.

Manton, Michael

Governance and management of green infrastructures for ecological sustainability: Wader bird conservation in a Swedish Biosphere Reserve

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Conservation governance approaches like Biosphere Reserves (BR) aim at managing the biosphere through the integration of nature conservation and sustainable use. Established in 2005 the Kristianstad Vattenrike BR area in Southern Sweden has been praised as a role model for good environmental governance. However, a literature review showed that the assessments of ecological consequences are so far very limited. We used the BR's wet meadow areas as a case study to review the ecological sustainability of the BR. The focal wader bird species of the wet meadows have declined due negative trajectories of land cover change, as well as increased risks of predation and competition. Other nature conservation challenges in this BR include the maintenance of sand steppe, and brownification of water. We stress the need for holistic analyses of social-ecological systems at multiple scales, including processes such as predation and other factors affecting waders, as well as how conservation and governance approaches can be improved by diagnoses of both ecological and social systems. Additionally, different approaches to landscape governance and management need to be examined to understand if and how social-ecological systems can be managed and sustained in the long term. This requires place-based transdisciplinary knowledge production and learning that includes both good governance and evidence-based knowledge about species, habitat and ecosystem processes.

Manzanedo, Ruben

Are the widespread European trees adapted to its local climate? Implications for climate change

Rubén D. Manzanedo

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Local adaptation is a key component of forest responses to climate change. It may promote current performance, but it may also reduce the potential for short-term response to changes. Also, pre-adapted migration and gene flow may facilitate re-adaptation to drier conditions. Finally, phenotypic plasticity may also largely contribute to performance. The balance between these factors remains unexplored for natural forests. Within the FunDivEUROPE project, we assessed local adaptation and differentiation for 5 dominant tree species across Europe. We used local and more southern ("future climate") provenances of the selected species in each region. We studied survival, morphological and physiological traits. Our results show adaptation to local conditions to be widespread among European dominant trees. In contrast, we did not find patterns of pre-adaptation to climate. This suggests that factors other than climate may drive local adaptation. We found strong phenotypic plasticity and a high trait overlap for provenances from regions up to 2°C warmer than the study regions, which suggests populations may cope with changes within this limit through plasticity. Both local adaptation and phenotypic plasticity contribute to tree performance and need to be considered in forest management.

Martínez Pastur, Guillermo

Cultural ecosystem services can be correlated with bio-physical variables using geo-tagged digital images in forested landscapes of Southern Patagonia

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Developing methodological approaches that spatially and explicitly address the social importance of cultural ecosystem services (CES) is needed for regional planning, but few studies have analysed their distribution on the basis of social perceptions. The objective was to identify CES hotspots and factors that characterize such hotspots, by defining spatial associations between CES in Southern Patagonia (Argentina). We used geo-tagged digital images that local people and visitors posted in the Panoramio web platform to identify hotspots of four CES (aesthetic value, existence value, recreation and local identity) and related these hotspots with socio-biophysical landscapes features. Aesthetic value was the main CES tagged by people, followed by the existence value of biodiversity, local identity, and recreational activity. The spatial distribution of these CES is associated with different socio-biophysical characteristics, such as the presence of water bodies, vegetation types, protected areas, urbanization, accessibility and tourism potential. The employed methodology allows us to define hotspots for different CES and to determine the socio-biophysical characteristics associated with their provision, according to specific particularities in the studied regions.

Martínez Pastur, Guillermo

Decrease of terrestrial net primary production (NPP) in Southern Patagonia (Argentina) during the period 2000-2013

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Terrestrial Net Primary Production (NPP) is fixed as biomass and it has been directly influenced by climate change during the last decades. However, such trends in southern Patagonia are not clear, and some authors reported a decline in this region´s temperature in the last decade. We used NPP data product derived from MODIS satellite images from 2000 to 2013 in seven forested and non-forested ecosystems, and regressed them with the sea surface temperature (SST), obtained also from MODIS images. NPP was different between vegetation types (mountain grasslands 320 grC.m^2.yr^{-1}, grasslands 390-450 grC.m^2.yr^{-1}, and *Nothofagus* forests 500-820 grC.m^2.yr^{-1}), and decreased over the studied period compared to the year 2000 (mountain grasslands -11%, grasslands -15% to -20%, forests -13% to -15%). SST, measured as annual mean temperate, was highly related to NPP (r^2=0.79), and also SST is related to the multivariate ENSO index during summer (r^2=0.58). The decrease in NPP could trigger many ecosystem alterations, changing natural dynamics and decreasing carbon uptake. Regional monitoring of NPP, both in long-term field plots and with satellite data, is essential to track changes in forest and grassland productivity under the novel climate change scenarios detected here for Tierra del Fuego.

Matthies, Brent

Optimal forest species mixture with carbon storage and albedo effect for climate change mitigation

Brent Matthies, Lauri Valsta

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Accounting for carbon storage and the albedo effect through offset permits can internalize the environmental externalities of forest landscape management. This can shift the economically optimal rotation age, and incorporate rents for a wider range of ecosystem services. A mixed stand economic optimization model was used to determine the optimal stand mixture and intra-species trade-offs. Climate mitigation trade-offs associated with the mixed forest dynamics between Silver birch and Norway spruce, were evaluated. The sensitivity of our results to absolute differences in albedo parameter values between species was also checked. The results indicated that a beneficial climatic trade-off exists between the two species. The optimal rotation age for combined case of carbon storage and albedo dynamics was the same as in the case of only carbon storage. Differences in absolute albedo impacts were most sensitive at high discount rates, under climate only management, and over increasing offset prices. This demonstrates the importance of improved parameter certainty in the promotion of climate offsetting in forestry. It also shows how mixed stands can promote more efficient trade-offs between forest ecosystem services and provide a basis for diversification between ecosystem functions.

Melecis, Viesturs

Long-term socio-ecological research in Latvia: Engure LT(S)ER

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According to the initiative of the International Long Term Ecological Research (ILTER) network each country belonging to the LTER network implemented at least one LT(S)ER (Long Term Socio-ecological Research) platform for investigation of interactions between environmental and socio-economic factors at multiple scales to improve predictive capacity of the effects of these interactions on biodiversity and ecosystem resilience. Latvia LT(S) ER platform is represented by the drainage basin (644 sq. km) of the coastal Lake Engure - a Ramsar site with the adjacent aquatory of the Gulf of Riga. A conceptual model based on DPSIR (Drivers-Pressures-States-Impacts-Responses) concept was worked out for the platform. The socio-ecological system was spatially demarcated and drivers were subdivided in two groups – external and local ones. The ecoregion was subdivided into seven zones demarcated by natural geological and geographical barriers. Each zone has a specific set of drivers and pressures as well as specific ecosystem structure. The analysis of the governing drivers and pressures was performed separately for each sub-region during three time periods – the 19th century - beginning of the 20th century, the period of Soviet occupation (1940-1991), the period after restoration of Latvian independence.

Melin, Markus

Forest structure matters: Revealing important habitats in a forest landscape by integrating airborne LiDAR data with GPS animal tracking

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LiDAR based mapping campaigns are expanding in numbers throughout the world. The lands are scanned for the purposes of topography mapping and forestry. Yet, as much of wildlife lives in forests, a very valuable data set is formed as a by-product. In a nutshell: 3D arrangement of habitat and its vegetation affect on how animals interact with their environment and lidar data provides information about this arrangement from the whole landscape with sub-meter accuracy. In our studies, we have integrated lidar data with known moose locations from GPS-collars. As a result, we have been able to track the target moose hour-by-hour and have literally seen the types of forests they have used under various conditions throughout the whole year. The method reveals very efficiently the vegetation attributes that are most important to a given species. Now, as lidar data covers more and more areas, it becomes possible to map important habitats or areas for a given species in a given landscape. In general, the situation keeps improving due to increasing use of GPS-collars for animal tracking and rapidly expanding lidar campaigns. Our studies provide good examples of how to integrate the two datasets and what can be achieved through it.

Moccia, Francesco Domenico

Stormwater management and new urban peripheries rehabilitation

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Stormwater is currently considered a source of flooding or landslide. In Italy newly established regional authorities are expected to prevent such risks; these authorities are limiting or prohibiting constructions and other uses as well as financing projects to mitigate such risks. In this paper we argue that the Basin Authority approach is unilateral and other positive facets of stormwater are not considered. Rain is not only a danger for human settlement but is also a source of life and a climate regulator. If risks and ecosystem services are dealt with reasonably in a combined way, stormwater management may be at the same time a resilient strategy and enhancement to ecosystem services. Our study started when the Sarno Basin Authority announced that it would open nine retention basins to mitigate recurrent flooding in the most urbanized areas. An alternative to such “end of pipe solution” is presented here and aims to harvest water and let it permeate in urban settings, improving the living conditions of citizens. At the fringe of metropolitan conurbation the quality of the river and hydrographic system are key levers of urban structure ordering, providing a potential network of open and public spaces.

Mononen, Laura

Modeling forest bird habitats and biodiversity with airborne laser scanning data

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It is important to observe spatial distribution of biodiversity and ecosystem services at different scales to provide sufficient information in order to meet the objectives of conservation and sustainable use of nature. To reach these goals, a concept of Essential Biodiversity Variables (EBVs) is introduced for the research community to develop scalable biodiversity variables using effective techniques and datasets (Pereira et al. 2013). Remote sensing techniques, especially Airborne Laser Scanning (ALS) allow us to provide information on forest landscape characteristics efficiently. Analyzing forest characteristics with citizen-science observations of forest birds enabled us to model suitable habitats for different species groups and look for areas where selected indicators suggest higher species richness. The piloting study is conducted in Vanajavesi catchment area in Southern Finland. New and efficient methods would add great value to traditional biodiversity monitoring that often base on expert evaluations and statistical analyses of long-term monitoring series. This study aims to build a more transparent link between biodiversity and ecosystem services.

Mõttus, Matti

Mapping boreal forest ecosystems using imaging spectroscopy

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Imaging spectroscopy (IS), also known as hyperspectral remote sensing is a technology which records the spectrum reflected by a target in a pre-defined wavelength region, usually in visible and shortwave infrared regions. Thus, the information content of IS data is much larger compared with traditional remote sensing systems which only measure in a small set of wavebands. We present two studies aimed at applying IS to quantify spatial and temporal changes in forest ecosystems. The investigations were carried out in Hyytiälä, Finland, southern boreal forest. We used aircraft-measured high spatial resolution (0.5 m) IS data (spectral resolution 9 nm) to demonstrate how forest reflectance is correlated with site fertility. The small pixel size allowed us to separate the sunlit and shaded parts of crowns. Overall, site fertility had a significant influence on the reflected signal with a stronger effect on the spectra of sunlit crown parts. Next, we used EO-1/Hyperion satellite data (spatial resolution 30 m, spectral 10 nm) to monitor forest activity during the growing season. The spectral signal was strongly affected by changes in observation geometry. Changes most related to in situ photosynthesis measurement were those related to needle chlorophyll content dynamics.

Nelson, Mark

Forest Canopy Disturbance Mapping in Northern United States

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We used summer Landsat time series stacks (LTSS) and a vegetation change tracker (VCT) algorithm to classify forest canopy disturbance in Michigan, Minnesota, and Wisconsin, USA, 1990-2009. We reduced commission of forest by incorporating a non-forest mask from seasonally persistent snow-covered winter LTSS. Forest age was inferred from year of canopy disturbance; age classes were assigned to forest pixels in the U.S. National Land Cover Database of 2011. The combined dataset was assessed using validation data from the U.S. Department of Agriculture Forest Service, Forest Inventory and Analysis (FIA) program, following "good practices" prescribed in Olofsson et al. (2014). Estimates of area and overall accuracy were produced along with corresponding 95% confidence intervals. We estimated 216,563 (±1,532) km^2 of forest land area, of which 26,635 (±1,134) km^2 was disturbed within the past 20 years; rates of forest disturbance varied among States. Overall accuracy for general land cover classes (forest/non-forest/water) was 89.5% (±0.0036%); accuracy was 84.9% (± 0.0042%) after stratifying forest into age classes. Additional results are reported for sub-regional accuracy assessments, and spatial distribution and landscape pattern of young and persisting forest.

Nelson, Mark

Conservation of Biological Diversity: Results from the United States National Report on Sustainable Forests — 2015

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Forest biological diversity contributes to human welfare in a number of important ways. Growing human population and consumption compromise the capacity of forests to provide ecosystem services sustainably. The Montréal Process (MP) provides a standard international framework for assessing a set of criteria and indicators (C&I) of the sustainability of temperate and boreal forest ecosystems and their ecological, social, and economic components. Twelve countries from Asia, Oceana and the Americas use the MP C&I. Europe formed its own C&I reporting system. The National Report on Sustainable Forests—2015 relies on MP C&I to organize and present data relevant to United States forests. The Report's first criterion, Conservation of Biological Diversity, is organized into nine indicators that address three sub-criteria: ecosystem diversity, species diversity, and genetic diversity. National forest inventories and land cover datasets are used to assess ecosystem diversity. Biological sampling activities are used to produce numbers of species for assessing species diversity. Declining populations and shrinking geographic ranges provide indirect measures of risks to genetic diversity. We present results from the U.S. 2015 Report for indicators of Conservation of Biological Diversity.

Nicasio-Arzeta, Sergio

Multi-scale disturbance factors drive the tree seedling community assembly in a fragmented tropical rainforest

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Although species loss and biotic homogenization are serious threats for tropical flora conservation in fragmented rainforests, their driving mechanisms remain poorly understood. We assessed the role of disturbance factors at local and landscape scale in the tree seedling community of a fragmented rainforest in southern Mexico. We characterized the seedling community through ten 1 x 1 m plots within 16 patches and estimated their richness, diversity, composition, and the abundance of individuals and functional groups. We used local scale (patch size, shape, presence of understory vegetation, tree vegetation structure) and landscape scale (distance to nearby matrix mosaics and propagule sources) factors as predictor variables. We found the abundance of shade-tolerant tree species was affected by the absence of understory vegetation and the proximity to propagule sources. They were replaced by disturbance-tolerant species, which proliferated nearby secondary forests, roads and villages. Species composition between undisturbed and disturbed patches diverged, where the latter presented a homogeneous assemblage between patches. These results highlight the fact that multi-scale disturbance factors drive tree seedlings assembly and homogenization in fragmented rainforests.

Olesk, Aire

Forest height estimation in Estonia from interferometric SAR data

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Synthetic Aperture Radar (SAR) satellites provide global all weather, day-and-night imagery with high spatial resolution and revisit cycle suitable for monitoring forests and detecting changes. In this study, single-pass TanDEM-X (TDX) bistatic observations and high spatial resolution X-band interferometric data were analysed to retrieve tree height of coniferous and deciduous forests during different seasons. TanDEM-X HH and VV polarization channel coherence images were studied over 300 hectares of forested areas in Estonia and compared with LiDAR forest height and national forest registry data. Coherence-based forest height estimation in homogenous forests indicated the high potential of TanDEM-X to provide reliable tree height estimates and develop new large-scale forestry applications. The regression models revealed a strong correlation between pine stands height and single-polarization interferometric coherence (HH-pol R^2=0.96, VV-pol R^2=0.97) and also for mixed deciduous tree stands during leaf-off period (HH-pol R^2=0.92, VV-pol R^2=0.94). Further analysis provided more details on the variation of the estimation accuracy by different environmental conditions, seasons, tree species and density, forest structure and precipitation prior to satellite data acquisition.

Paal, Taavi

Critical properties of woody corridors for forest dwelling species in fragmented forest landscapes

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Woody corridors in fragmented landscapes have been proposed as dispersal enhancing landscape elements or as surrogate habitats for forest plants. Our aim was to define ecological filters limiting forest specialist plants dispersal into and along corridors. We sampled 50 forest–corridor transects in agricultural landscapes of southeastern Estonia. We extracted limiting drivers by searching for trait convergence between forest specialists and two habitat generalist groups (forest generalists and common corridor plants) and building a prediction model of forest-specialists migration distance. We found that species richness and the proportion of forest specialists decreased sharply from forest interior to first meters of corridor while species richness of generalists remained constant. Species occurrence was mainly associated with traits related to establishment and environmental tolerance. Light conditions were important for both species groups in corridors, while corridor age and width supported specialists and suppressed generalists. The results indicate that dispersal-related traits had a low functional role in plant migration into corridors. We conclude that most woody corridors are only stepping-stone habitats for habitat generalist species, and not for forest specialists.

Pamukçu, Pinar

Soil conservation and water production services of ecosystems and their inclusion into landscape planning in sprawling cities

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Green spaces in urban and peri-urban landscapes provide benefits to humans which we call ecosystem services. Soil conservation and water production are two major interrelated ecosystem services that are of particular importance in reservoir watersheds or ecologically vulnerable landscapes. Sprawling cities may have substantial negative impacts on ecosystems. As a common approach, water production services of ecosystems are handled in terms of quality, quantity and regime. Forests are known to regulate water regime, increase quality but also decrease water yield. The major mechanism behind this is the loss of water via transpiration and interception by the canopy. Specifically, the ecosystem compartments that regulate water quality and regime, are the litter and soil layers in a forest ecosystem. For our methodology we combined spatial land-use stratification, litter layer thickness and weight, leaf area index, soil permeability, geomorphology data with water quality and peak discharge rate. Our results supported findings that the highest peak flow rates tend to occur in urban areas followed by croplands and forests and the best quality of water is obtained from forestlands. We concluded that the parameters we tested have potential to be used in a land planning process.

Parro, Kristi

Impact of post-fire management on forest regeneration in a managed hemiboreal forest, Estonia

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Fire is a significant disturbance in boreal and hemiboreal forests creating a large amount of dead wood, causing alterations in vegetation species composition and soil seedbank. Little research has been conducted on the combination of fire and post-fire forest management, even though knowledge about previous fires should be included in management planning. Post-fire management impact on natural regeneration (abundance, tree species composition and tree growth) was studied in Scots pine *(Pinus sylvestris L.)* forests 2 and 22 years after fire. The study included 5 types of management treatments combining fire, management and the amount of standing trees in different variations. The study introduces post-fire management treatments and explains their effect on the development of regeneration and impact on different tree species, emphasizing the importance of acknowledging the influence of treatment during management planning. Suggestions for management are provided bearing in mind forest recovery.

Peacock, Joshua

Restorative Engagement: A speculative theoretical concept and method for validation, which has potential to inform how health and shared (social) value aspects of the landscape are linked

Joshua Peacock

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The concept speculatively aligns restorative and aesthetic experience further to a review and synthesis of aesthetic and psychological theory and research. An outline method is derived from this, which is proposed for use in landscape perception studies as part of landscape character and visual survey methodologies. This comprises the identification of Patterns of Restorative Engagement (PRE), which can be used to infer value within the landscape, informing landscape sensitivity and the evaluation of this. Patterns are defined from the association of recreational activities with apparently self-sustaining natural processes. Validation of the concept and method is proposed through identifying how individuals (of differing age, sex, background) particular PRE are influenced by their brainwaves of restorative experience, using mobile EEG (electroencephalography). This may be used to identify any discrepancy in culturally inferred value, relative to recorded restorative benefit. This is likely to be relevant for landscape amenity planning and design for people in general, informing resource management and prioritisation of investment. This may inform ecosystem services valuation, relative to the associated recorded health benefits of restorative experience.

Pelorosso, Raffaele

Ecosystem services based planning and design of green infrastructure for sustainable cities

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Green Infrastructure (GI) is a network of natural and engineered ecological systems, localized at landscape scale and fully integrated with the built environment. GI provides a wide and diversified range of Urban Ecosystem Services and is able to increase the resilience of urban systems toward several risk categories (e.g., hydrological and climate change risk). Two main components of the GI in particular are presented and discussed here: Non-Urbanized Areas (NUAs) and Best Management Practices (BMPs). NUAs include cultivated land, abandoned farmlands, grassland, woods and shrubs, often located at the peri-urban cities' fringes where they provide all the major categories of Ecosystem Services. BMPs are technical solutions developed to control pollution, runoff and, in general, to ensure sustainable urban water management (green roofs, pervious surfaces, constructed wetlands, detention basins, infiltration basins, filter drains). BMPs aim to mimic the natural and semi-natural structures present in the environment, furnishing similar provisioning, regulating, supporting and cultural functions and services. We present applications and discussions about this GI view in different urban contexts in order to support sustainable urban planning strategies.

Pérez-Rodríguez, Fernando

AppTitude©: A tool for forest suitability assessment

Fernando Pérez-Rodríguez, João Azevedo

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Forests provide different services and products in processes involving diverse groups of stakeholders with particular perceptions and perspectives. The relationship between forest uses and stakeholders can be more or less compatible, which affects forest management decisions. Part of the solution for potential conflicts among forest uses and stakeholders relies on the definition of the best locations for different uses: it depends on gathering and processing information and on establishing a framework for optimal (or satisfactory) forest management decision making. The AppTitude© software was developed to evaluate the suitability of landscape for different forest uses based on stakeholder's judgment and minimum-maximum limitations (inputs). The software implements and automatized Multi-Criteria Decision Making (MCDM) methodologies were used to evaluate suitability according to a hierarchy of different types of criteria (e.g. social, economic, environmental, political, and technical) associated with spatial information through attributes connected to vector or raster files. Finally, the software solves automatically the hierarchy and spatial probability distribution to obtain spatial suitability surfaces (output raster files) for particular use and regions.

Pérez-Rodríguez, Fernando

A new tool for evaluating road transport fuel consumption and CO_2 emissions based on open geographical databases

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The analysis of road transport costs and efficiency relies strongly on the availability of spatial data which in some regions are difficult or expensive to obtain. Open geographical databases seem therefore a promising alternative for these regions. OpenStreetMap©, due to permanent development and improvement by a large number of collaborators, is able to provide reliable data at no cost; as a result, the development and application of specific geographic information tools in most locations becomes possible. In this work we developed routines for forest logistics based on data from OpenStreetMap©, specifically to evaluate fuel consumption and costs as well as CO_2 emissions in wood transport in the Northeastern region of Portugal, where the road network is strongly affected by topography that has impact on forest logistics and the viability of alternatives of wood mobilization. We applied our methodology in a real case study of transport of forest biomass to a pellet plant, deriving surface estimates of fuel consumption, fuel costs, CO_2 emissions, and accessibility performance to be used as criteria for deciding on support systems for forest management and planning in the Northeastern region. This application demonstrates the importance of available geographic information data and tools in forest mobilization.

Peterson, Urmas

Cross-border comparison of forest cover changes in northeastern Europe caused by disturbances and afforestation of abandoned agricultural land

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We studied the area of Estonia, Latvia, Lithuania and western regions of Russia. This area was part of the Soviet Union for half a century, and during this period land management practices in these areas were similar. The area has undergone forest cover increase throughout the 20th century. Secondary succession of forests on marginal arable land has contributed to this trend during the post-Soviet period. Forest disturbances and appearance of shrub land or forest patches on abandoned agricultural land were assessed, using moderate resolution Landsat images covering a time period from 1985 to 2014. These images were supported locally with high resolution satellite images, orthophotos and database data if available. Our results show that forest harvesting rates were moderate until the early 1990s, accelerated over several years after the system changed in 1991, leading to higher levels of forest fragmentation. Forest disturbance rates differed markedly among the countries and also locally. At the same time, we found locally extensive appearance of forested patches on abandoned farmland. Spatial patterns of afforestation of abandoned agricultural land were locally different. The analysis of the latest images reveals that deforestation and afforestation dynamics seems to change again.

Pollastrini, Martina

Towards a new multidimensional indicator of tree crown status

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Foliar features can be subdivided into morphological, chemical, and physiological traits, disease or damage symptoms. Foliar analysis of forest trees is, usually, employed in large scale monitoring programmes, taking into account only chemical traits. Leaf collection may be the most difficult, time-consuming and costly phase of a field survey. It is recommended that once a sample is collected, a multiplicity of foliar analyses be carried out. Within FunDivEUROPE project an integrated approach of foliar sampling and analyses was conducted in six European forest types. The surveys performed include chemical analysis (total nitrogen and carbon leaf content, carbon stable isotopes), physiological analysis (chlorophyll a fluorescence) and symptoms (presence and diffusion of insects and pathogens).The aim of the presentation is to explore the correlation between leaf traits and make an attempt to combine different parameters describing aspects of crown status into a synthetic indicator that estimates tree responses to climate variables and diversity. The current study focuses on comparing compensative and non-compensative approaches to synthesizing foliar data, by considering which method is more appropriate to the studied phenomena and type of data.

Potter, Kevin

Drinking from the fire hose: Detection of spatial and temporal patterns in fine-scale forest health data collected across a continent

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For more than a decade, U.S. government agencies have collected standardized fine-scale forest health data that span the width and breadth of the country. These data sets include ground-based data (the Forest Inventory and Analysis system of approximately 120,000 plots), data collected from fixed-winged aircraft (aerial surveys of forest insect and disease damage), and data collected by satellite (daily MODIS satellite detections of fire occurrences). Making this information useful for forest health monitoring efforts poses a challenge, however. I will describe methods to detect spatial and temporal patterns within such fine-scale data sets, and then provide examples. One approach identifies statistically significant geographic hotspots of a phenomenon. It divides the country into hexagonal cells, in which data are aggregated, then identifies clusters of cells within which values exceed those expected by chance. Another approach quantifies the degree of deficit or excess of a phenomenon (fire occurrences per area of forest, for example) within an area in a given year relative to previous years. Such analyses have become standard components of recent annual USDA Forest Service national Forest Health Monitoring reports on the status and trends of forest health across the nation.

Potter, Kevin

When (and where) does forest biodiversity matter? The ecological importance of evolutionary diversity across broad regions

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Biodiversity conveys numerous functional benefits to forested ecosystems, including community stability and resilience. Biodiversity metrics that account for evolutionary relationships among species may be better surrogates for functional diversity than traditional measures such as species richness. We conducted two broad-scale studies applying evolutionary diversity measures to assess forest function across broad scales. In one, we assessed trends in live aboveground tree biomass (LAGB) in relation to tree biodiversity calculated on 79,000 Forest Inventory and Analysis (FIA) plots across the United States. We found that biodiversity was more closely associated with greater LAGB on low-productivity sites with low tree stocking. This is consistent with the expectation that the coexistence of functionally different species increases forest productivity in less productive and more stressful environments. In a second study, we describe the associations between several evolutionary diversity metrics and invasive species diversity and cover on approximately 39,000 FIA plots across the Southeastern United States. We found positive relationships between each of the evolutionary metrics and the degree to which plots were invaded, but this varied across the Southeast.

Prizavoite, Dana

The facets for overgrowing process of agricultural land in moraine hillock of Vidzeme

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Overgrowing of agricultural land has become a common process in contemporary landscapes in European marginal areas. The secondary succession process on abandoned agricultural land in Latvia is characterized by deciduous tree species; however, recent research has confirmed that in some parts of Latvia this process has taken place with coniferous tree species as well. The aim of research was to determine the main historical and recent factors which have influenced the successional changes in moraine hillock. The study was conducted in the central part of Latvia, encompassing part of the Vidzeme Upland – Mezole Hillock. Soil samples were taken and vegetation was described in 23 plots selected to represent the diversity of successional series. The results showed that the secondary succession process on the abandoned agricultural land up to the mid-20th century took place mainly with deciduous tree species. Soil moisture and bare soil patches were the main impacting factors of overgrowing process. Currently the main tree species in secondary succession process, however, is Picea abies; the change was due to spreading of nutrient-rich soils with tall and dense herbaceous vegetation. Our research provides new ideas about ecosystem processes on abandoned agricultural land.

Privitera, Riccardo

Transferability of green cities experiences for urban ecosystem services enhancement

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During the last decades European green cities' urban projects have been designed according to high level of Urban Design Solutions (UDS) such as green spaces networks and low-carbon mobility systems. Even though the implementation of UDS has shown an effective enhancement of urban ecosystem services, their transferability in different urban contexts has not been systematically investigated. This paper proposes a method for evaluating the transferability of fifteen European green cities UDS to urban contexts of southern Italy, where socio-economic and environmental conditions are different. The method is based on three different steps. First, UDS are identified and grouped within a matrix in three strategic categories (economic, urban quality, environment). The second step checks the transferability of these UDS according to six criteria, varying from climatic to cultural aspects. The third step is the evaluation of UDS transferability based on a survey conducted through web-interviews with Italian national experts in the field of urban planning. Contrary to expectations, the results show that a very high percentage of UDS could be transferred to southern Italy contexts and that their transferability is more influenced by lack of urban management policies than climatic features.

Puhacheuski, Alyaksandr

Forestry and biodiversity conservation in Belarus

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Forests occupy about 40% of Belarus' territory and are the largest natural ecosystems, some of which are still untouched by economic activity. All forests are state owned. It allows organising centralised forestry, and making top-down decisions for biodiversity conservation. The presentation provides information about how these two conflicting goals are achieved in Belarus. In particular, one of the most effective mechanisms is the FSC certification, which forces forest enterprises to pay more attention to conservation of biodiversity. Another direction is identification of habitats of protected species and preparation of relevant documents for their conservation by experts. In this case forest enterprises have to fulfil specified requirements.

Pärn, Jaan

A global pattern of methane and nitrous oxide fluxes from swamp and bog forests

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The study uses data from global soil, and N_2O and CH_4 gas sampling campaign. The objective was to analyse N_2O and CH_4 emissions related to peat conditions in swamp and bog forests. We measured 21 swamp and bog forest sites under various climates: 3 alder swamps and 3 artificially drained bog pine forests in Estonia (Jan-Dec 2009), 2 bog forests in Transylvania/Romania (Apr 2012 & June 2014), 3 cypress swamps in the Everglades (Apr & Dec 2013), 2 bog forests in West Siberia (July 2013) and a bog forest in Tasmania (Jan-Feb 2014). The N_2O and CH_4 effluxes were measured with 3-10 dark static chambers per site. Groundwater was measured from sampling wells. The most significant independent factor for site average CH_4 fluxes was groundwater depth – an exponential relationship, R^2=0.42, p=0.0007, n=21. The N_2O fluxes showed a decreasing (power) relationship with the C/N ratio – R^2=0.53, p<0.0001, n=21. Related to groundwater level, the N_2O fluxes peak at around -40cm. Overall, variation in greenhouse gas fluxes was largest in more favourable conditions - at optimal water table (+5 to -20cm) for CH_4 and at low C/N for N_2O. The results agree with previous data in literature but are the first to draw such conclusions from a global campaign following a uniform protocol.

Rautiainen, Miina

Remote sensing of the seasonal cycle of boreal forests

Miina Rautiainen

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Understanding the seasonal dynamics of boreal ecosystems and linking their phenological phases to satellite reflectance data is crucial for efficient monitoring and modeling of northern hemisphere vegetation dynamics and productivity trends in the future. Satellite remote sensing enables continuous global monitoring of vegetation status and is not limited to conventional, single-date phenological metrics such as budburst or flowering. Using remote sensing also allows gaining a wider perspective of the seasonality of vegetation dynamics. At its best, remote sensing can reveal large-scale phenological trends that would be impossible to detect from the ground. The seasonal reflectance course of a boreal forest observed in optical satellite images is a result of the temporal cycle in optical properties of both the tree canopy and understory layers. Seasonal reflectance changes of the two layers are explained by, for example, a complex combination of changes in biochemical properties and geometrical structure of different plant species as well as seasonal variation in solar illumination. This presentation provides a synthesis of recent studies dedicated to monitoring the seasonal cycle of southern boreal forests at different spatial scales, based on satellite and field data.

Remmel, Tarmo

Morphologies of boreal wildfire footprints and residual vegetation patches in Northwestern Ontario across spatial scales

Tarmo Remmel

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The concept of emulating natural disturbances (END) is not new, but is continually evolving as our understanding of natural systems and processes improves. This study examines the morphological structure of wildfire footprints and insular residual stands of boreal vegetation to learn about both the disturbed areas, but particularly the unburned forest fraction following a wildfire. Special attention is paid to 11 wildfires in Northwestern Ontario, represented at 5 spatial resolutions that were ignited by lightning strikes and never suppressed. Measurements of morphological structures characterizing footprints and residual stands provide tangible and visual understanding of disturbances. This work compares the mapping and characterization of wildfire footprints and residual vegetation patches across spatial resolutions, focusing on scaling effects on morphological representations. The results indicate more severe shifts among morphological element proportions within residual vegetation patches than for entire footprints when spatial resolution decreases. The trends indicate that using a spatial resolution coarser than 16 m leads to a loss of stability that otherwise exists at higher spatial resolutions.

Rendenieks, Zigmars

The potential for forest biodiversity conservation optimization at the regional level in Zemgale planning region, Latvia

Zigmars Rendenieks, Olgerts Nikodemus

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Nature conservation efforts in Latvia mainly focus on establishing and managing specially protected nature areas. However, a number of studies have shown that for more comprehensive approach it is necessary to initiate and develop conservation incentives outside legally protected areas, for example, in commercial forests. Woodland Key Habitats and High Conservation Value Forests are important concepts developed as tools for voluntary protection in forest ecosystems in Nordic and Baltic countries. Since Zemgale planning region is dominated by agricultural lands, connectivity of forest habitats is especially important for biodiversity conservation. In this study we calculated the potential to optimise the area and structural connectivity of protected forest stands by simulating spatial pattern supplementation. Forest stands above felling age in all habitat groups were selected as potential supplements in this simulation.

Rendenieks, Zigmars

Factors of forest landscape change in Latvia during 25 years – results of a multi-scale study

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The results of this study showed that changes in timber resource structure and socio-economic transition in the forest sector were the main drivers for forest policy development in Latvia. These changes also influenced the adoption of normative regulations as well as management practices implemented by the state forest management company "Latvijas valsts meži", which in many cases had a significant impact on forest landscape structure. The results demonstrate that changes in harvesting volume and the corresponding changes in forest landscape patterns were determined by stand age structure and forest road network (i.e. stand accessibility); however, after 2008 the most important factor was the decision to increase allowed felling volume, which increased the fragmentation of forest matrix and the number, total area and edge density of clearcut patches. The decision to increase allowed felling volume (in force during 2009–2010) was the most important step in forest policy that influenced forest landscape pattern. A significant rise in clearcut aggregation in all analyzed landscapes after 2008 shows that the introduction of concentrated felling practice during 2008–2011 amplified the effect of increased harvesting volumes on spatial patterns of forested landscapes.

Riitters, Kurt

Assessing forest fragmentation from global tree cover change, 2000 to 2012: What can we say and how important is that information?

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A recent global assessment of forest interior dynamics is used to demonstrate opportunities and problems for enhanced spatial-temporal analysis of remotely sensed forest maps. Global forest maps at 0.09-ha scale from 2000 and 2012 were used to identify changes in forest interior area at 1-km2 scale. Forest area trends underestimated forest fragmentation, a 1.71 million km^2 (3.2%) net loss of global forest area at pixel scale translated to a net loss of 3.76 million km2 (9.9%) of forest interior area at landscape scale, and those differences were pervasive among 433 ecological regions in forest biomes. Attention is often focused on tropical forests but extra-tropical forest interior area comprised half of the global total in forest biomes, and loss rates in temperate forests approximated the rates in tropical forests. The analysis highlights different areas of concern if the objective is to manage either the total area of forest interior or the patterns of forest change that caused the highest rates of fragmentation. This presentation focuses on the strengths and weaknesses of remote sensing versus in situ approaches to global forest fragmentation assessments.

Rozas-Vasquez, Daniel

From understanding to practice in the integration of the ecosystem services approach in SEA and spatial planning in Chile

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Spatial planning is one of the most relevant policy instruments driving future land use changes. In this process it is possible to generate impacts on different ecosystem services, which support human activities and well-being. In this sense, SEA plays a fundamental role for incorporating the ecosystem services approach under environmental and sustainability assessment of spatial plans. Considering this, there is an increasing concern about the institutional context and the lack of common understanding about the key elements of SEA and ecosystem services by those who make the decisions. The objective of this work is to identify understanding among different institutional actors in Chile in relation to key concepts in SEA, ecosystem services and their integration in spatial planning. For this, interviews were performed and later a questionnaire was applied across the country. After obtaining the results, the network and statistical analysis were carried out, considering the key concepts, their relations and other quantitative attributes. With these results, we have obtained an institutional overview of perceptions, gaps and places where intervention could be necessary for effective and strategic utilization of these frameworks.

Rösler, Wolfgang

Heavy metal contamination in forest soils: A combined magnetic-chemical site assessment in Schwarze Pumpe area, Eastern Germany

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Industrial high temperature processes like coal combustion in power plants or steel production emit fly ashes which contain both highly magnetic phases and hazardous pollutants. These are released into the environment, are transported and distributed through the atmosphere, and get deposited and accumulated in the soil. Due to their common origin and transport path, magnetic phases can serve as proxies for heavy metal pollution in the soil. In contrast to chemical analyses, measurements of magnetic susceptibility on soil surfaces and in soil profiles can be performed inexpensively and fast in high spatial resolution. For site investigation, a stepwise combined approach, based on magnetic screening and subsequent targeted chemical testing at a limited number of sampling locations is proposed. To explore and demonstrate the potential and efficiency of such an approach, a large dataset of magnetic soil surface measurements, shallow vertical profiles of soil magnetic susceptibility, and heavy metal analyses was acquired in forest soils near Schwarze Pumpe, a major brown coal power plant and industrial complex in the Lausitz area, Eastern Germany. At the same cost, a combined magnetic-chemical assessment can deliver a more significant result of the spatial distribution of pollution than chemical testing alone.

Saarela, Sanna-Riikka

Participatory integrated appraisal of forest bioenergy production

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Forests play a crucial role in climate change mitigation by acting as a carbon sink. Intensified removals of logging residues – for the purpose of bioenergy production – will affect forest carbon sequestration capacity. Removals of organic material can also decrease soil productivity, which in turn can have negative impacts on water quality, recreation and species that rely on decayed wood. This paper presents the results of a participatory integrated appraisal of the impacts on forest bioenergy production on the provisioning of regulation and maintenance (carbon sequestration and water quality maintenance), provisioning (energy and timber production) and cultural ecosystem services (recreation and landscape). We have applied multi-criteria analysis (MCA) methodology in Hämeenlinna municipality to structure the problem according to the key dimensions and elicit stakeholder preferences for different services provided by forest ecosystems. The results show that there are trade-offs, conflicting goals as well as different preferences for different stakeholder groups between different ecosystem services related to forest bioenergy production. Based on the results, preliminary recommendations for bioenergy policy and sustainability criteria for forest bioenergy production can be made.

Sandström, Per

Co-production of methods and knowledge to empower local communities: The case of Sami reindeer husbandry

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In northern Sweden, forestry, wind and hydropower, mining, infrastructure development and associated influence zones together constitute a complicated land use situation that impact reindeer husbandry. Individual and cumulative impacts among different land use systems are often a source of conflict. In search of solutions, Sami reindeer herders, researchers and stakeholders initiated a process to co-produce methods and knowledge to support and strengthen the knowledge base and to improve and inform ongoing land use dialogues. Key findings from the collaborative process were that diverse groups can work together and co-produce methods and tools that increase stakeholders' engagement and ability to negotiate and find solutions. Furthermore, by co-producing knowledge, the use and understanding of compiled information improved. The co-production created an exigency for conventional research that then informed the tools and increased the potential contribution towards improved dialogue. This work can potentially serve as a stronger foundation to safeguard the continuation of the complex land use system of reindeer husbandry, which constitutes both a fundamental component in the indigenous Sami culture and a key to successful sustainable landscape management.

Sat Gungor, Beyza

Examining recreational use in cultural services of Belgrad Urban Forest in Istanbul, Turkey

Beyza Sat Gungor

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Istanbul is the largest city of Turkey with the population of 14 160 467 people and Belgrad urban forest, located in the Northwestern part of Istanbul, approximately 20 km from the city center, seems to be incapable of meeting the recreational requirements of population. Belgrad Forest has been mainly important for its water, water purification, soil production, flood regulation, ornamental resources, and medicinal resources, regulation services (e.g. climate regulation, carbon sequestration), and cultural services (recreational uses, aesthetic value). Due to increasing population, recreational function of the forest has gained dominancy over other functions. Picnicking, jogging, walking, cycling and sight-seeing are the types of outdoor recreation activities most preferred by people. Besides cultural services provided by the forest, supporting, provisioning and regulating ES services is also important. The total area of the forest is 5,442 ha, but the area allocated for recreation activities is 181.5 ha. Previous studies revealed that the recreational carrying capacity has already been exceeded. The aim of the study is to ensure that alternative proposals on optimum management will be submitted according to recreational requirements by considering sustainability principle.

Scherer-Lorenzen, Michael

A biodiversity and ecosystem service research platform in European forests

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We outline features for a European network of research sites to assess the role of biodiversity for the delivery of ecosystem services in forests, mainly based on the FunDivEUROPE project. In general, forest tree composition, tree identity and the local environment, especially climate, largely drive forest functions in forests, including production. In addition, tree biodiversity plays an important but so far neglected role in the functioning of forests. Increased diversity affects many individual forest functions and their combination, i.e. ecosystem multifunctionality.The main challenges for future development of functional biodiversity research in forests are the consideration of a more comprehensive set of forest functions and services, of their relevance for different types of stakeholders, of the role of diversity within and between tree species relative to, and in interaction with, the context of other drivers, and of diversity effects at the landscape scale, including the design of “optimal” landscapes. To address these challenges, we suggest a hierarchical research approach combining a) experimental sites, b) intensively studied comparative sites with a clear diversity-targeted design (“exploratories”), and c) systematically coordinated forest inventory networks.

Schäfer, Elisa

Mapping tree species diversity of a tropical montane forest by unsupervised clustering of airborne imaging spectroscopy data

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Remote sensing has much potential for biodiversity mapping, and high spatial resolution imaging spectroscopy (IS) allows for direct estimation of tree species diversity based on spectral reflectance. Our objective was to test an approach for mapping tree species diversity that takes advantage of an unsupervised object-based clustering. Tree species diversity was predicted for a tropical montane forest in the Taita Hills, Kenya, based on spectral variation of IS data. The predictions were validated by tree species diversity estimates based on field data. According to the results, the approach succeeded well in revealing tree species diversity patterns in terms of species richness, Simpson's index and the Shannon–Wiener index. Especially tree species richness was well predicted, with similar accuracy for indigenous forest and plantation sites (RMSE=3 species, r2=0.50). Tree species richness could be mapped for the study area directly based on the clustering results without using the field data. The presented approach takes advantage of the capability of IS to detect spectral differences between tree species, but without the need for training and validation of data, which is expensive to collect. With further development, the approach could be applied for estimating beta diversity.

Sepp, Kalev

The distribution of High Nature Value farmland in Estonia as an indicator of biodiversity

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The concept of High Nature Value (HNV) farmland has been widely accepted in Europe as a useful index correlated with biodiversity. A review of HNV in Estonia showed that more detailed national data were required in order to obtain better definitions of the patterns of HNV than was available from European data. An expert group identified 15 indicators from a potential list of 80 (the criterion was that they should cover the whole country). These were divided into three groups, linear features, protection status and landscape. Small woodlands, belts and lines of trees were included in a single measure, the Simpson Index, to reflect landscape mosaics which are major contributors to HNV and strongly correlated with biodiversity on farmland. Large forests, although important for biodiversity, are not farmed. The statistical analysis of 15 indicators showed that an expert system was required rather than a direct scoring additive routine: the variables are at different scales and they also need different weights. The final map of HNV will be presented and its potential value in the formulation of policies for nature protection will be discussed.

Shushkova, Alena

Implementation of Ecological Network: Case of Belarus

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Ecological Network is a spatial structure of natural and semi-natural areas which allow for biodiversity conservation in fragmented landscape. The most controversial issue of implementation of ecological network is how to transform ecological corridors into reality. In Belarus the National Ecological Network has been developed since 2002. By 2014 a couple of projects have been realized (Development of National Ecological Network and Development of Ecological Network in Vitebsk Poozer'e (Vitebsk region)), with focus on possibilities for its implementation. As it is stated in the existing legislation, only areas with special land use regime can be regarded as ecological corridors. It was agreed with local authorities and other stakeholders that additional restrictions and changes of existing regimes of land use will not be planned. As a result, the majority of the corridors in the newly introducedscheme are planned within water protection zones. Most of the forest corridors have been excluded from the project during the agreement process. The next step should be the establishment of ecological corridors on the ground, including green infrastructure such as green bridges and eco-ducts.

Sil, Ângelo

Ecosystem services and landscape change: Quantification and valuation of carbon sequestration dynamics in the Sabor River's upper basin

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Forest ecosystems provide multiple services including climate regulation through e.g. Carbon Storage and Sequestration (CSS). However, the dynamics of this Ecosystem Service (ES) is strongly influenced by Land Use/ Land Cover (LULC) changes. In order to understand the influence of these changes in the provision of this ES through time, we quantified, mapped and valued CSS in the Sabor River's upper basin (northeastern Portugal) using the InVEST model. The assessment relied on the interpretation of LULC changes between 1990 and 2006, the estimation of carbon stocks, economic valuation and the simulation of three alternative landscape scenarios for 2020. The results suggested that between 1990 and 2006 the variation of the CSS occurred mainly due to changes in LULC and especially due to the increase of the availability of forest tree biomass. Over this period, we estimated an increase of carbon stored; its distribution among the different carbon pools varied depending on LULC types. However, for all LULC types, soil was identified as the main carbon pool. In the future the expansion of forest areas in the landscape, related to a realistic scenario of rural abandonment, can further enhance carbon sequestration, eventually adding value to the climate regulation ecosystem service.

Sil, Ângelo

Using ecosystem services trade-offs analysis to promote the incorporation of change into planning and management in a conservation area in Northeastern Portugal

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The Montesinho Natural Park in Northeastern Portugal was established in 1979 to preserve a rich and diverse land mosaic maintained by moderate levels of human disturbance. The area has gone through fast social and economic changes that impacted the landscape and its natural values. Howevere, the Natural Park has been unable to incorporate these changes into planning and management. In this work we analysed changes in landscape composition and configuration and in the provision of various ecosystem services in a medium-sized watershed within the natural park from 1990 to 2006. Ecosystem services such as timber, firewood, mushrooms as well as agricultural production and freshwater (provisioning services) and carbon storage and sequestration, also water regulation and purification (regulating services) were evaluated and mapped using published statistics, land use/land cover data, and modelling tools. Trade-off analysis between different ecosystem services helped to identify and quantify trends of social-ecological change in the area. Based on our results, we discuss strategies of incorporating change into planning and management and supporting adaptive management in the natural park by establishing a framework of indicators of ecosystem services.

Simoncic, Tina

Linking the concept of forest functions and ecosystem services in multi-objective forest management

Tina Simoncic , Andrej Boncina

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Linking the concept of ecosystem services (ES) with forest multifunctionality has received increased research attention. However, a gap still exists between this research and current approaches in forest management. We contrasted two concepts: the ES and the concept of forest functions as a traditional tool for providing data on forest multifunctionality in Central Europe. We analyzed the main pros and cons of the concept of forest functions and examined the challenges and opportunities in applying ES to forest management with emphasis on identified weaknesses of the current concept of forest functions. The ES concept can improve the designation of forest function areas by explaining the relations between spatial features and the potential of ecosystems to deliver the desired services, identifying new demands for services, or serving for better communication with public. In addition, mapping and structured classification of ES may also provide the foundation for economic evaluation of forest services. However, harmonisation of both concepts is needed, since forest function areas have commonly been driven by local concerns that do not fit within the global scheme of the ES concept. We discuss possible improvements of the concept of forest functions using selected case studies from Slovenia.

Soler, Rosina

Integrative forest management using variable retention balancing timber and biodiversity conservation in Southern Patagonia

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Forests provide several ecosystem services, but traditional management is focused in provision, disregarding other services and conservation. Variable retention harvesting (VR) was suggested to maintain postharvest original structure and diversity. Here, we test the performance of VR in conserving biodiversity, synthesizing results from long-term data in *Nothofagus* forests. We included 533 study cases measured 1 to 8 years postharvest (YAH), comparing the effect of aggregated (AR) and dispersed retention (DR) with primary forests (PF). We calculated z-effect sizes for each comparison and used random-effect models with categorical data. Species typical of PF kept its populations in AR, but not in DR. Species from other habitats were negatively affected by AR, but positively by DR. The temporal trends showed an increase of richness (highest values for 1-2 YAH) and abundance (highest values for 5-8 YAH), due to allochthonous plants, being stronger in DR than AR. VR impacted in harvested areas, mainly in DR, due to the increase of allochthonous species and those autochthonous from other associated non-timber habitats. However, in AR, plants, insects and birds of primary forests were maintained in seemingly stable populations and similar conditions to forests with natural dynamics.

Soosaar, Kaido

Net ecosystem exchange and soil respiration in a hemi-boreal pine forest

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Long-term carbon dioxide (CO_2) measurements based on the eddy covariance method make it possible to assess the exchange of carbon dioxide (net ecosystem exchange, NEE) across the interface between the ecosystem and the atmosphere during periods of different length. The mean average NEE – 5.2 t CO_2-C ha^{-2} a^{-1} indicates that during the first measurement period (August 2013 – August 2014), Soontaga pine forest (South Estonia, 58°01'N 26°04'E) sequesters CO_2. This is in accordance with other research that has been carried out in this climate zone.The NEE showed a clear diurnal trend: during the daytime, the forest sequestered CO_2, while during the night and late night, CO_2 emitted from the ecosystem to the atmosphere.The results of NEE and soil respiration obtained can be divided into two: the growing period and the rest period. During the growing period, the sequestration of CO_2 by plants was greater than soil respiration, and the ecosystem sequestered carbon. Since soil respiration had a positive correlation with soil temperature, its values were higher specifically during the vegetation period. During the resting period, the ecosystem became an emitter of CO_2. The studies on C cycling in Soontaga are ongoing, and future challenges are related to the long-term C budget in the soil.

Spyra, Marcin

Ecosystem services in cross-border landscape planning – comparing landscape development in Czech Republic and Poland

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Cross-border landscape planning is the issue not well described in the literature. It is also an emerging issue, important for different stakeholders in Czech – Polish borderland. The analysis of the part of Czech – Polish cross-border landscape, located within Upper Silesia cross-border region, indicates significant asymmetry of the landscape in the context of biodiversity of different local ecosystems. Czech part of the cross-border landscape is characterized by higher potential to provide ecosystem services, while the Polish part benefits from ecosystem services. Moreover, disproportions between Czech and Polish land-use planning legislation are evident. Thus the need for sustainable planning approaches, suitable for cross-border landscape ecosystem services, becomes urgent. Theoretical considerations about landscape planning approaches are presented and discussed in the context of cross-border ecosystem services specificity. Experiences from three projects, implemented in Upper Silesia for Euroregion Pradziad, Euroregion Silesia, are also discussed.

Stanturf, John

60 years of landscape change in West Africa: Community resource use and protected areas

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Swidden agriculture is a traditional form of farming in the Tropics. Swidden and other traditional practices are difficult to detect and monitor using remote sensing due to their dynamism and the small footprint made by individual farmers in traditional communal tenure systems. As a consequence, traditional land uses are inadequately represented in national and sub-national land use/land cover mapping. We studied land cover change over a 60-year period around selected communities and nearby protected areas in Bombali District, Sierra Leone and Kindia Prefecture, Guinea. Manually interpreted satellite imagery from 1965, 2000, 2007 and 2013 produced land cover maps of 5 km radii around 4 communities, and 5 x 5 km areas (25 km^2) in 4 nearby protected areas (2 pairs in each country). Land cover changed about 10% of every 7 years, but up to 5% was due to natural vegetation cycles. Although the cycle of swidden was difficult to determine, much of the woody savanna has been degraded across the region. In Guinea permanent agriculture expanded dramatically up to 2000, in Sierra Leone major cover types have been fragmented. Occasional logging cleared gallery forests and increased in Sierra Leone (5% of forest lost in last 8 years). Mining and habitation have small imprints but they occur.

Stryamets, Nataly

Biosphere reserves for biodiversity and human well-being? A case study from Ukraine

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The Biosphere Reserve (BR) is an approach that seeks to simultaneously reconcile and promote conservation of natural and cultural diversity, environmentally and socio-culturally sustainable economic development, and research. This study focuses on how the BR concept has been legitimized as a tool for sustainable development (SD) in Ukraine, and what impact it has had on BR implementation on the ground. We analysed national legislation and its specific provisions for BRs to understand the legal function of this concept, and how the BR concept was perceived by different stakeholders engaged with the Roztochya BR initiative in Ukraine by conducting interviews with local stakeholders. The BR concept is incorporated into Ukrainian national nature conservation legislation; however, the aim to promote sustainability by stakeholder collaboration is poorly reflected in Ukrainian law. Legislative misplacement of the BR concept created deep misunderstanding among local people during the emergence of the Roztochya BR initiative.

Sugimura, Ken

Forest use and its regulation in the Gunung Halimun Salak National Park, West Java

Ken Sugimura

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The Gunung-Halimun-Salak National Park was established to preserve natural forests and biodiversity. On the other hand, around 100 thousand people living in and around the park have been dependent on forest resources for their life, while the government imposes some regulations on the forest uses. In this study we asked local people to carry GPS, when they enter the park area to harvest non-timber forest products. We found that they harvested various items within around 500m from the park border, including the zones in which the regulations prohibited such activities. Comparing the Indonesian park zoning system with the Japanese along with monitoring records of some indicator species of the park, we thought there must be some room for compromise that would lessen the conflicts between the regulations and the local people's forest use in Indonesia.

Sugita, Shinya

Changes in disturbance regimes and their impacts on forest dynamics: Palaeoecological perspectives

Shinya Sugita

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Long-term regime changes in natural and anthropogenic disturbances affected vegetation and land-cover dynamics in Europe and elsewhere in the Holocene. Over the last few decades, for example, increased occurrences of extreme climate events such as strong hurricanes and severe droughts have impacted forested areas in Estonia and other parts of the Baltics. Recent studies have suggested a possible “tipping point” or threshold, beyond which a stable state of vegetation and ecosystems shifts to another state triggered by regime changes in physical and biological disturbances and climate factors. However, modern ecological datasets are often too short to evaluate the extent to which those factors would affect vegetation and ecosystems. Sedimentary records of plant and animal remains, charcoal and geochemical tracers from lakes and bogs provide insights into long-term impacts of various disturbance agents on the resilience and stability of vegetation. This paper summarizes the current understanding of the patterns and processes of the Holocene vegetation and land-cover changes caused by the regime shifts in fires, storms and other disturbances of various spatial and temporal scales in temperate and boreal forests in northern Europe and North America.

Zamora López, Sheila Edith

Payments of environmental services and their effects on the structure, composition and connectivity of an agroforest landscape in Esparza, Costa Rica

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The study aims to evaluate the effect of payments by environmental services (PES) on the structure, composition, connectivity of an agroforest landscape in Esparza, Costa Rica. The study area included 2074.5 ha and 60 farms of the project "Silvopastoral Approaches for Integrated Management of Ecosystems" financed by the GEF and the World Bank. The farms were stratified in three schemes, A (control), B (4 years of payment), and C (2 years of payment), and three sizes, large (> 50 ha), medium (21 to 49.9 ha) and small (1 to 20.9 ha). The base line (year 2003), 2004 and 2010 were compared among 13 land uses (riparian forest, secondary forest, agroforestry systems) and 11 socioeconomic variables. Likewise, landscape characteristics (17 metrics), type of schemes and farm size were evaluated by multivariate statistics. The results highlight that the PES has a great potential for improving the landscape matrix characteristics in fragmented agroforest landscapes. However, the viability of maximizing this potential will depend on the strategies that conciliate the farms' limitations and the intensity of cattle production versus provision of environmental services. Therefore, the PES schemes should be flexible mechanisms that could be adapted worldwide.

Zawadzki, Jaroslaw

Reducing influence of forest litter on the assessment of potential soil pollution using field magnetometry

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Field magnetometry is a method that is widely used to determine the potential soil pollution with heavy metals. Numerous studies prove that soil magnetic susceptibility is strongly correlated with a concentration of heavy metals in soil. Soil magnetic susceptibility is commonly measured on the soil surface with a MS2D Bartington device, but in forests soil magnetic susceptibility measured with a MS2D device can be negatively influenced by the thick organic soil horizon. In this study measurements of soil magnetic susceptibility were performed on the soil surface and in the soil profile using MS2D and MS2C Bartington devices, respectively. Study sites were located in the forests of the Upper Silesian Industrial Area. Potential soil pollution was assessed on the basis of MS2D Bartington measurements, and selected parameters of the distribution of magnetic susceptibility were used as additional variables in cokriging. The results of geostatistical integration of MS2D and MS2C measurements were validated using chemical measurements and the Pollution Load Index. The results showed that using soil magnetic susceptibility measured with the MS2C device as a supplementary variable improved significantly the precision of estimation of potentially polluted area.

Zawadzki, Jaroslaw

Estimation of soil moisture in root zone by means of triangle method using MODIS and Landsat imagery

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Soil moisture (SM) is one of key factors for biomass production. It is also a very important parameter in fire risk estimation. Obtaining soil moisture information using field measurements over large areas, with satisfactory temporal and spatial resolutions, is either too expensive or practically impossible. Therefore, satellite soil moisture studies in forest areas are particularly important and challenging tasks, not only because of vast area of observations and complex dynamics of SM changes, but also due to dense forest vegetation that hinders the use of new generation microwave satellite sensors. In this work, the authors present the so called triangle method of SM estimation in the root zone, using satellite imagery in optical and infrared bands. The method makes it possible to calculate spatial distribution of temperature vegetation dryness index, TVDI. The presented method is especially useful in root zone soil moisture estimation. It is the fact of great importance because TVDI provides actual information about water available for plants. Depending on the chosen sensor, which allows satellite imagery to work in required spectral bands, it is possible to evaluate SM in different spatial and temporal resolutions. In this work MODIS and Landsat satellites were used to estimate SM.

Zellweger, Florian

Environmental predictors of species richness in forest landscapes: Abiotic factors vs. vegetation structure

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The advent of LiDAR remote sensing has fuelled studies on the relationship between vegetation structure and species diversity in forest landscapes. Yet, the relative importance of vegetation structure and other major determinants of species richness, such as climate, remain controversial. Here, we used environmental predictors representing climate, topography, topsoil pH and vegetation structure to predict species richness of plants, butterflies and birds across forest dominated landscapes in an environmentally heterogeneous region (Switzerland) in Central Europe. Within our ensemble modeling approach we investigated the relative importance of each predictor variable, and predictor variable group. Forest plants were predicted most accurately, followed by woodland butterflies and birds, with R^2 values of 0.67, 0.54 and 0.44, respectively. Vegetation structure was related to species richness of all taxons, and improved particularly in the predictions of butterfly and bird species richness. Our results suggest that mobile species are strongly affected by the structure of the vegetation, providing rich niche diversity in the 3D habitat space. This further implies that maintaining vegetation and habitat structure constitutes a promising way to conserve biodiversity in forest landscapes.

Zhang, Yuxin

On scale dependence of diversity-scale relationship: The beta diversity component perspective

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Beta diversity is a measure that incorporates two important scale-related components: The spatial grain, which corresponds to alpha diversity, and the spatial extent which corresponds to gamma diversity, and thus lends itself naturally to a study of scaling. We explore the scale dependency of beta diversity and scale relationship, both theoretically as well as by the application to actual data sets. Our results showed that a power law exists for beta diversity-area (spatial grain or spatial extent) relationships, and that the parameters of the power law are dependent on the grain and extent for which the data are defined. Coarse grain size generates a steeper slope (scaling exponent z) with lower values of intercept (c), while a larger extent results in a reverse trend in both parameters. We also found that, for a given grain (with varying extent) or a given extent (with varying grain) the two parameters are themselves related by power laws. These findings are important because they are the first to simultaneously relate the various components of scale and diversity in a unified manner. Further theoretical consideration and wide exploration in other communities on these patterns is suggested.

Zlender, Vita

Urban dwellers' experience of peripheral green open spaces

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This research explores the characteristics, use of and accessibility to, urban peripheries of two European cities with contrasting spatial strategies: Ljubljana (green wedges strategy) and Edinburgh (green belt strategy). By using mixed method approach which involved qualitative and quantitative methods, the study assessed the effectiveness of both strategies to enable urban dwellers the experience of peripheral green open spaces.The comparison of two cases showed the differences in the frequency of green space use and in the type of activities performed there. Whilst green wedges' areas were used frequently but for shorter period of time, the green belt offered people a space extensive enough for activities that require more space and time. The study concludes that neither of the two strategies is effective enough in ensuring satisfying experience of peripheral green open spaces in growing urban systems. Instead, a combination of both strategies may be an alternative approach. In this way, green corridors are ensured which connect city centre with its outskirts where extensive but managed open areas are preserved. In addition, this study creates a basis for a planning approach, using a methodology which takes into account users of peripheral green open spaces.

Tenerelli, Patrizia

Mapping cultural ecosystem services through crowd-sourced information: Landscape perceptions and patterns

Patrizia Tenerelli, Sandra Luque

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The realization of the growing demand for cultural services (CS) calls for methods to identify and quantify them in order to plan for the provision of such services. Assessing revealed preferences of CS are challenging, especially when considering the spatial dimension needed for planning at the regional level. Most of the current studies on CS are based on socio-economic data or specific surveys which are collected on a declarative basis. Spatially explicit data on location for nearby recreation are especially difficult to obtain. The analysis cultural services, Flickr, photoseries, preferences, geotagged, landscape perceptions, well-beingof photo series and data mining from social media can be used as a surrogate of interviews or surveys to assess recreation behavior, perception and preferences, assuming that visitors are attracted by the location where they take photographs. We will present a case study using crowd-sourced information as a suitable proxy for empirical estimation of visitation. The analysis of photo series is a pragmatic, cost effective way of gathering space-and time-referenced data on visitation which can be used to represent observed people's preferences. The photos were analyzed in order to identify hotspots of service delivery and landscape properties which represented the major predictor of nearby recreation activities.

Trasune, Laura

Nature conservation and spatial development in Latvia

Laura Trasune

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Development of nature management plans is a way to coordinate nature protection and management, spatial development planning and use of natural resources. Many specially protected areas in Latvia do not have nature management plans at all or they are outdated. Due to unsufficient financial resources, the process of elaboration of nature management plan in Latvia is slow and unsatisfactory. However, the situation in nature may change fast. The process of updating the nature management plan is almost as slow and complex as developing a new plan. A topical issue is still to apply a common approach to integrate nature protection requirements into spatial development documents. The analysis of planning process shows that elaboration of nature management plan jointly with development of municipality's spatial plan can accelerate their preparation process, improve the quality as well as the implementation of the plan.

Ustsin, Uladzimir

Experience in the development of the management plan for the transboundary protected area: National Park «Braslavskie ozera» (Belarus) – Protected Landscape "Augshdaugava" (Latvia)

Uladzimir Ustsin

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The first for Belarus transboundary protected area was established in late 2014, the cooperation agreement was signed between the National Park "Braslavskie Ozera"(Belarus) and landscape reserve "Augshdaugava"(Latvia). As a result of the project LLB-2-258 (Cross-Border Cooperation Programme Latvia-Lithuania-Belarus, implemented within the framework of the European Neighborhood and Partnership Instrument), the Harmonized Management Plan for cross-border territory was developed. An international team of experts prepared the founding principles; Latvians carried out the analysis of valuable natural complexes and protected sites, also produced detailed maps. Bielorussians thoroughly described the state of biological and landscape diversity in the cross-border area. The directive part of the document presents a profound analysis of the factors that have a negative impact on natural ecosystems, species and communities. The main result of the document is providing a complex of measures to minimize the negative factors affecting conservation work and facilitating sustainable use of natural resources of transboundary protected areas.

Uuemaa, Evelyn

Visual assessment of landscape: A case study from Estonia

Evelyn Uuemaa, Mirjam Potter

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Although landscape aesthetics, landscape perception and local identity have been studied for many years, the quantitative evaluation of the quality of a landscape remains a challenge because of the temporal dynamics of the landscape, the scale dependence of the view, 3-D difference, and differences between observers' abilities of perception. The aim of this study was to estimate people's preferences about different concepts describing the landscape – visual scale (openness), naturalness, maintenance, diversity – and to assess visual amenity. We used photos of South Estonian landscapes for the survey of visual evaluation of the landscape. The survey was carried out in two groups: local residents and the students, total of 129 people. For every photo the extent of the viewshed and land use was specified. For all the viewsheds several landscape indicators were calculated and correlated with landscape preferences. The results showed that openness and naturalness had the strongest relationships with landscape metrics and people generally preferred more diverse landscapes. No significant differences by age and gender were found; however, a statistically significant difference occurred between the ratings of men and women, and local residents and students.

Valbuena, Rubén

Unravelling forest structure change over forested landscapes with Lidar and Gini coefficient

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We carried out an analysis of the Lorenz curve to quantify the complexity of forest structure, and classify woodlands into forest structural types, using airborne laser scanning (ALS) for evaluating differences at landscape scales. The Lorenz curve links the shape of a tree diameter distribution with its basal area-weighted counterpart through their ranked cumulative distributions. When applied to study tree sizes in forests, the Lorenz curve expresses the dominance of each tree in relation to its relative contribution to the total stem density and basal area. The Gini coefficient (GC), a measurement of the area under the Lorenz curve, was applied to discriminate uneven-sized forest areas from even-sized ones. For this purpose, we employed its middle GC=0.5 value, which asymptotically corresponds to a theoretical uniform distribution and therefore represents maximum entropy. Moreover, studying the asymmetry of the Lorenz curve proved useful for evaluating the relative development in the understory, and therefore characterizing competition conditions among tree populations. These methods applied to ALS remote sensing have allowed evaluating patchy patterns in forest structure and assessing differences across landscapes related to management practice.

Verheyen, Kris

Understanding the drivers behind patterns of associated biodiversity in mixed forests in Europe

Kris Verheyen, Evy Ampoorter, Lander Baeten, Luc Barbaro, Eric Allan, Hervé Jactel, Hans De Wandeler, Bastien Castagneyrol, Yohan Charbonnier, Julia Koricheva, Harriet Milligan, Alfons van der Plas

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Species associated to trees and forests help to maintain functioning of the ecosystem and provisioning of ecosystem services. These functions and services generally depend on multiple, interacting taxa across different trophic levels; therefore it is of key importance to understand the drivers behind associated diversity patterns across taxonomic groups. However, the relative importance of multiple drivers on multiple taxonomic groups has not yet been assessed in a fully comparable and integrated way. The Exploratory Platform of the FunDivEUROPE project, a network of >200 plots encompassing a large tree diversity gradient and distributed over six major European forest types, was used to elucidate the effects of tree species richness and composition, forest type and climate on the abundance and diversity (taxonomical, functional, phylogenetic) of microbes, earthworms, understorey plants, insects, spiders, birds, bats and ungulates. In a first step, a mixed model was applied for each taxonomic group to extract the relative contributions of the drivers to explain abundance and diversity patterns. Second, their contributions were compared between the taxonomic groups in search of common patterns and/or differences.

Verheyen, Kris

Biodiversity and ecosystem services of small forest patches in agricultural landscapes across Europe

Kris Verheyen, Alicia Valdés, Pieter De Frenne, Jonathan Lenoir, Guillaume Decocq

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Although the multiple ecosystem services (ES) provided by large forests have been widely acknowledged in the literature, little is known about the ES provided by small forest fragments embedded in agricultural landscapes. Despite their small size, these forest patches have a crucial role as refugia for biodiversity in these anthroposized landscapes and probably also as providers of ES. In this lecture, we synthesize the outcomes of the smallFOREST project (ERA-NET BiodiERsA, 2012-2015), which aimed at assessing the multiple drivers of biodiversity, ES and benefits for society of small forest patches along a large latitudinal gradient, spanning from southern France up to Estonia. In 250 forest patches distributed over 16 landscape windows along the gradient, the diversity of six taxonomic groups (vascular plants, mushrooms, carabids, woodlice, millipides and spiders) has been assessed. For the same landscapes and patches, seven ES have been quantified and valued (production of usable plants, production of edible mushrooms, production of wood, carbon sequestration, pest control by carabid beetles, prevalence of tick-borne diseases and landscape enjoyment). We will present a quantification of biodiversity and ES in the studied patches and landscapes, analyse whether or not they covary, and assess whether or not they share a common set of drivers

Vesterdal, Lars

Is tree species diversity or tree species identity the most important driver of soil carbon stocks?

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Studies of functional species diversity effects have reported complementarity effects for aboveground carbon (C) sequestration, but the question remains whether higher soil C stocks could result from belowground niche differentiation. We studied soil C stocks in tree species diversity gradients established within the FunDivEurope project to study biodiversity-ecosystem functioning relationships in six European forest types. We found no effect of species diversity on total soil C stocks (forest floor and 0-20 cm) across six European forest types, but there was a positive effect of diversity on C stocks in the forest floor C stock and 0-10 cm layer. In contrast, there was a strong effect of species identity (broadleaf vs. conifer) and its interaction with site-related factors. Within the Polish forest type we sampled soils down to 40 cm and found that species identity was again the main factor explaining total soil C stock. However, species diversity increased soil C stocks in deeper soil layers (20-40 cm), while species identity influenced C stocks significantly within forest floors and the 0-10 cm layer. We conclude that total C stocks are mainly driven by tree species identity, but diversity effects may occur within certain site types or layers within the soil profile.

Vihervaara, Petteri

Integrating remotely sensed data and biodiversity for ecosystem assessments

Petteri Vihervaara[1], Laura Mononen[1], Ari-Pekka Auvinen[1], Raimo Virkkala[1], Yihe Lü[2], Inka Pippuri[3], Petteri Packalen[3], Rubén Valbuena[3], Jari Valkama[4]

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Biodiversity and ecosystem functioning underpins the delivery of all ecosystem services and should be accounted for in all decision-making related to the use of natural resources and areas. However, biodiversity and ecosystem services are often inadequately accounted for in land use management decisions. We studied a boreal forest ecosystem by linking citizen-science bird data with detailed information on forest characteristics from airborne laser scanning (ALS). We describe this method, and evaluate how similar kinds of biological data sets combined with remote sensing can be used for ecosystem assessments at landscape scale. The results support the use of the selected method as a basis for quantifying spatially-explicit biodiversity indicators for ecosystem assessments. We also assess how the available data sources can be developed to be compatible with the concept of essential biodiversity variables (EBV), which has been put forward as a solution to cover the most important aspects of biodiversity and ecosystem functioning. We suggest that EBVs should be integrated into environmental monitoring programmes in the future, and citizen science and remote sensing methods need to be an important part of them.

Vogt, Peter

Measuring landscape fragmentation, a holistic approach

Peter Vogt

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The design and evaluation of forest resource policies requires tools for monitoring and quantifying the impact of human activities on forest landscapes. The assessment of fragmentation is a key component for understanding and interpretation of landscape dynamics but it is usually provided only as a qualitative description for a specific species living in the landscape under study. In contrast to the common practice of addressing and then trying to summarize the different aspects of fragmentation, we use a holistic approach and measure the image object complexity describing the information content in the image. The results are normalized, quantitative fragmentation metrics related to the overall degree as well as the spatial distribution of fragmentation of any land cover type. Based on geometric principles only these measures can be applied at any spatial resolution. Normalized fragmentation indices address several important tasks: the concise state assessment on a given site, a base for reliable statistics on temporal changes, and the inter-comparison of fragmentation for different sites. Operational tools to measure fragmentation, and other image properties, are summarized in the free software GuidosToolbox (http://forest.jrc.ec.europa.eu/download/software/guidos).

Väisänen, Sari

Appreciation and demand of ecosystem services of forest streams

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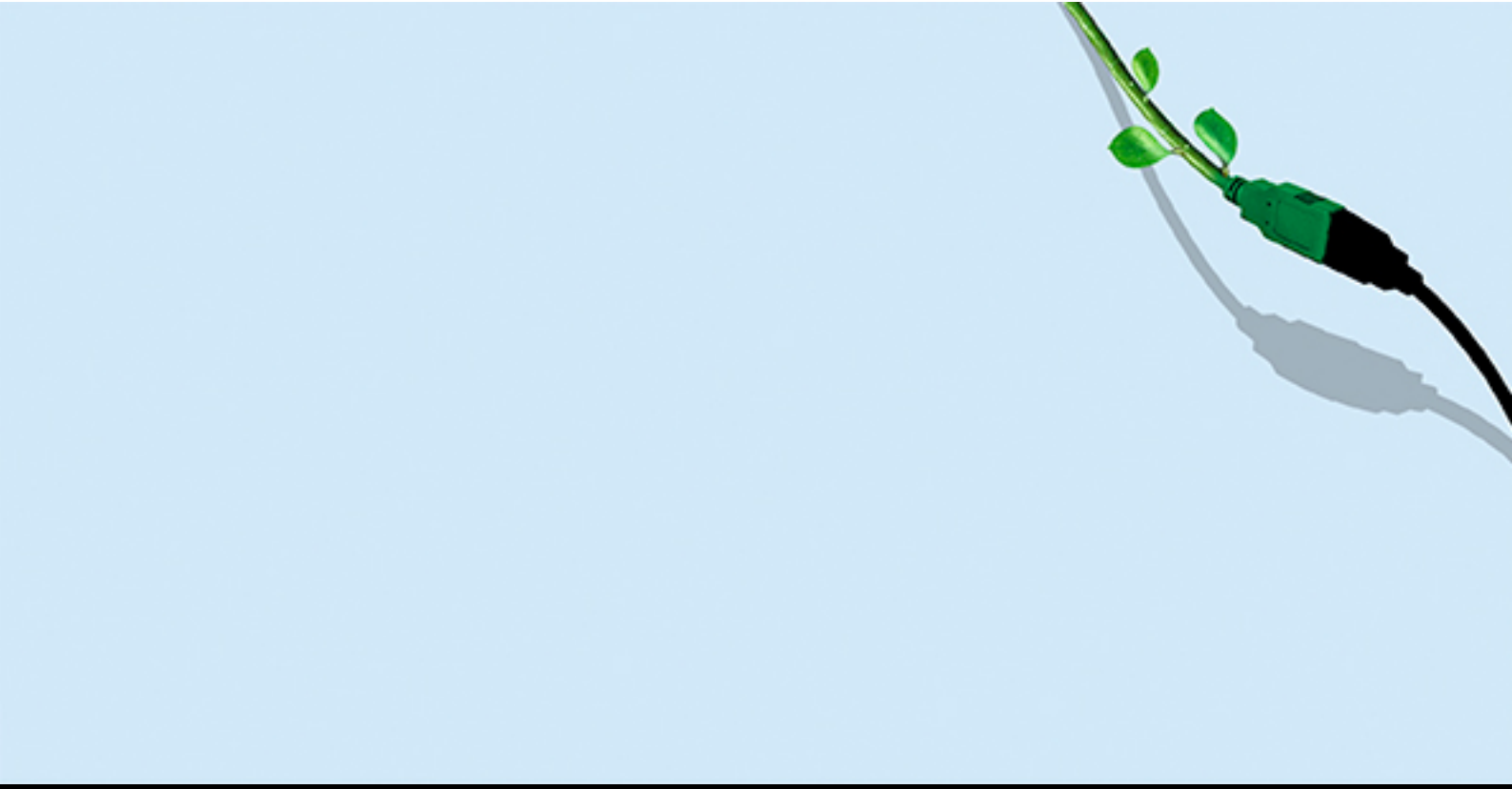
The condition of many Finnish forest streams has been deteriorating for decades due to forest drainage and the consequent sedimentation. We studied residents' and forest owners' attitudes towards the streams' deteriorating state and their restoration in sparsely inhabited River Iijoki basin in North-Eastern Finland. We were especially interested in how different groups of residents, i.e. forest owners and entrepreneurs, value forest streams and ecosystem services the streams and surrounding forests provide and if this could produce new insights, e.g. how to concretize and communicate the benefits of ecosystem restoration to wider public. We estimated with an economic valuation method the local households' willingness to pay for the restoration of local forest streams and studied which ecosystem services are considered worthy of higher contribution. According to our results with 667 respondents and a response rate of 39%, appreciation of biodiversity and landscape are significant factors determining higher contribution especially among forest owners; half of our respondents were forest owners.



Poster presentations

Bogdan, Sorina Mihaela

Assessing ecosystem services across landscape scenarios: The sediment retention service in mountain landscape in the Romanian Carpathians

Sorina Mihaela Bogdan, Ileana Patru-Stupariu, Liliana Zaharia, Andreea Andra-Topârceanu

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The ecosystem services concept offers an interdisciplinary approach to the integrative study of both socio-economical and ecological systems. Thus, our study aims to assess the link between possible future land cover changes and erosion mitigation services. The analysis focuses on a mountain landscape from Iezer Mountains in the Romanian Carpathians.To this purpose we developed three landscape scenarios (Conservation, Business-as-Usual, Development) with participation of local stakeholders, using the Scenario Generator tool from InVest. We also considered recent changes in the forest landscape, highly under threat from illegal deforestation. The scenarios were compared in terms of their ability to provide sediment retention. We assessed the service using the InVest Sediment Delivery Ratio Model, both in biophysical terms – sediment retention rate, and economic terms – the avoided maintenance costs (for the reservoir that serves as the outlet of the watershed).The results show differences especially between the conservation and development scenarios. They are relevant for decision making in case of new development projects and forest management, contributing therefore to integration of the ecosystem services concept in planning activities at a local level.

Brin, Antoine

Using connectivity analysis to optimize a network of set-aside forests in a managed landscape: A case study in a French mountain national park

Antoine Brin[1], Anne Jacquin[1], François Calatayud[2], Michel Goulard[2], Laurent Larrieu[3], Claire Crassous[4], Marie-France Leccia[4], Daniel Demontoux[4], Sylvie Duthoit[1], Alexandre Ravelet[1], Lionel Valladares[1], Hervé Brustel[1], Marc Deconchat[5]

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Maintaining landscape connectivity participates to biodiversity conservation efforts. But quantifying connectivity suitably still remains a challenge. In this study, we propose a method to establish a network of permanent set-aside forest patches to preserve taxonomic biodiversity. In the Mercantour National Park (French Alps), we selected patches of high conservation potential with a multi-criteria analysis based on the Weighted Linear Combination method. Five ecological criteria were combined: ancientness, time since the latest logging, presence of forest habitats of priority interest for the Park, levels of maturity and of taxonomic richness. Then, permanent set-aside forest patches networks were proposed according to their capacities to ensure structural and functional connectivities. The functional connectivity was measured using spatial tools (Conefor and Circuitscape) for a selection of saproxylic beetles with a large range of dispersion capacity. The uncertainty of this type of connectivity analysis is high because of the lack of ecological knowledge and data. Thus, we compared different scenarios based on a hypothesis of landscape matrix permeability to test the robustness of the results.

Cellini, Juan Manuel

Effects of landscape variables on active restoration strategies of restoring *Nothofagus* forests degraded by invasive beavers in Tierra del Fuego

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An agreement between Argentina and Chile to eradicate invasive species was signed due to low resilience of Patagonian forests to the impacts generated by beavers *(Castor canadensis)*. Passive restoration was ineffective, necessitating active strategies. Plantations in abandoned ponds consist of *Nothofagus pumilio (lenga)* and *N. antarctica (ñire)*. We analyzed the influence of biotic and abiotic factors in 3 micro-habitats: front and tail of ponds and cut non-flooded areas. Five-year-old lenga seedlings had 39% survival in front, 21% in tails and 46% in cut areas in year-3, being negatively influenced by plant cover and soil moisture. Lower height growths were recorded during year-1 (0.7-0.9 cm/year), but increased with time (1.9 cm/year front, 1.6 cm/year tail, 4.3 cm/year cut areas). At 4 locations across bioclimatic zones, 10-40 cm ñire plants attained 17% survival in meadows (front and tail) and 30% in cut areas, being higher in larger plants (25% vs. 18%) influenced by rainfall (4% in sites <400 mm/year and 41% in >400 mm/year). The main damage was from above-ground biomass dryness, but root survival allowed the emergence of new shoots. It is necessary to monitor different *Nothofagus* species in the environments across landscape to determine feasibility of restoration plans.

Cojoc, Emilia

Boundary connectivity effects on species biomass in grassland vegetation sustained by grazing

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Spatial habitat configuration and grazing activity influence the pattern of plant biomass and the distribution of species diversity. A field study was conducted to assess the influence of habitat connectivity on the distribution of species biomass and richness. We investigate two types of habitat connectivity: grassland to grassland (all patches connected to grassland) and grassland to forest (one patch or all patches connected to forest). We find no significant difference in above-ground plant biomass among different types of connectivity [values ranging from 530 g m-2 to 590 g m-2]. Grasses biomass decreases [P< 0.001] with connectivity to forest while bryophytes and shrubs biomass increases [P<0.001]. The biomass of the dominant species *Deschampsia cespitosa (L.) Beauv.* decreases with connectivity to forest [P<0.0001], while the biomass of *Nardus stricta L.* remains constant. Species richness was highest where the entire grassland was connected to forest. We find no significant relationship between species richness and distance to forest. Plant species with restricted temperature requirements (microthermophytes, hekistothermophytes) and nitrogen-fixing legumes were present only in the areas connected to forest.

Cuenca, Pablo

Measuring the avoided deforestation of protected area in Tropical Andean Forest

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Most governments are inclined to think that establishing protected areas (PAs) represents the best strategy for reducing tropical deforestation and conserving the biodiversity of Andean tropical forest. Measuring the effectiveness of PAs is difficult because the amount of deforestation that would have occurred in the absence of legal protection cannot be directly observed. Conventional methods of evaluating the effectiveness of protected areas can be biased as protection is randomly assigned. In this study, we assess the role of PAs against deforestation in the Andean tropical forest of Ecuador. We demonstrate that estimates of effectiveness can be substantially improved by controlling the biases along dimensions that are observable. We find that protection reduced deforestation: approximately 7% of the protected forests would have been deforested had they not been protected. Furthermore, spillover levels were significantly lower inside protected areas than outside their borders. Our results show that with appropriate empirical methods conservation scientists and policy makers can better understand the relationships between humans and natural systems and use this knowledge in attempts to protect critical ecosystem services in Andean tropical forest.

Dhar, Amalesh

The world heritage Sundarbans mangrove forest in Bangladesh: Ecosystem services and their linkage to poverty alleviation

Amalesh Dhar, Lael Parrott

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The Sundarbans mangrove forest is one of the richest natural resource areas in Bangladesh. It represents one of the largest mangrove forests in the world and has been recognized as an internationally important World Heritage and Ramsar site. It plays a significant role for providing a wide range of floral and faunal biodiversity and ecosystem services (ES) that support the livelihood of local communities as well as economic progress of Bangladesh. Despite their importance to human well-being, such ES and natural capital are in general rarely tracked in national economic accounts and are unaccounted for in measures of economic progress. A range of historical data for ES and indicators of human wellbeing were used to describe the evolving trade-offs between ES and poverty of this area. The results reveal that non-timber forest products and fish production are the most highly valued provisioning services, which are directly linked to local people's wellbeing. As a supporting service, habitat significantly contributes to conservation of the Bengal tiger and Irrawaddy dolphin populations, providing also protection from cyclones. In addition to this, the forest could considerably contribute to poverty alleviation if economic benefits could be drawn from such non-consumptive services like tourism and carbon credits.

Forray, Rosanna

Urban fabric and vegetation cover in neighborhoods are typical of historical urban development tendencies

Rosanna Forray, Sonia Reyes-Paecke, Magdalena Vicuña, Francisco De la Barrera

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Urban development patterns of Latin American cities mirror the social and economic development processes that occurred during the 20th century. Until the 1980s, urban growth presented a radio-concentric pattern regulated by public policies. From the 1980s onwards, urban growth has been led by the market and shows two trends: sprawl and densification. This research explores different morphological patterns of the city fabric, resulting from contrasting public policies in Santiago de Chile. It is focused on the spatial relationship between vegetation cover, built-up cover and density of buildings. In order to find the potential for vegetation networking of each spatial configuration at different scales, we extracted vegetation cover in 11 neighborhoods. Google Earth imageries were used and a supervised classification was applied. Older neighborhoods located in the city center showed low vegetation cover in a lineal arrangement embedded in a dense urban matrix, in consolidated central and peripheral areas vegetation cover represented the matrix, and in peri-urban area social housing formed unvegetated islands immersed in agricultural landscapes. After 40 years of market-driven urban growth some public goods, among them open vegetated spaces, have become scarce.

Girdziušas, Sigitas

Forest Regeneration Inventory - practice in Lithuania and Estonia

Sigitas Girdziušas, Marek Metslaid

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The chosen regeneration method and targeted tree species determine future forest characteristics. Therefore it is in state's interest to have reliable data on forest regeneration: that allows predicting future forest features and serves as a basis for decision making process. Regeneration as well as forest inventory incurs only costs, besides tree species composition can change in the long run. Thus we might face a risk when seeking for short-term efficiency and considering forest regeneration inventory a less important aspect. This study analyses forest regeneration inventory related legislation, rules, codes of practice, etc. of Lithuania and Estonia in 2015. The mentioned documents were obtained from official legislation registers and forest survey implementing institutions. This study focuses mainly on compulsory requirements of forest regeneration inventory (regeneration quality, characteristics) as well as inventory methods (visual evaluation, measuring, distance methods, etc.). Data is analyzed and comparison is made using mainly qualitative comparative and content analysis methods. The study analyses not only forest regeneration features to be inventoried but also tries to question the value of collected data, seeking for most efficient inventory approach.

Jakovels, Dainis

Wooded dune habitat mapping and evaluation using airborne remote sensing data: Case Study Lake Engure Nature Park

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Assessment of habitats is generally carried out by traditional methods of field surveys that have proved themselves a reliable approach. However, the main drawbacks of field campaigns are their time-consumption and limited area coverage. Airborne remote sensing techniques (RS) can cover large territories in very short time providing useful information to support habitat experts. Airborne remote sensing data from hyperspectral imaging, LiDAR and high resolution RGB sensors were available for this study. High resolution RGB imaging was used for visual assessment of the area. Mapping of wooded dune habitat was done mainly from LiDAR data (digital terrain model and normalized digital surface model). Parameters related to tree size and shape, were derived from both LiDAR data and hyperspectral data, but viability/stress indices from spectral data. The results show that the use of RS data increases the accuracy of site border identification. It allows getting information on site quality – crown cover, tree size, as well as viability/stress and detection of single standing dead trees. Spatial pattern of bigger/older trees within stands was clumped at short distances, but dispersed at larger distances.

Jankovska, Ilze

Edge effect and trampling in urban forest fragments – impacts on the understory vegetation

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Vegetation in urban forests is heavily affected by fragmentation and recreational load. The most significant consequences of fragmentation are edge effects. Edges of forest fragments are easily invaded by species from surrounding ecosystems and typically have higher plant species richness and cover. Also, competitive, synanthropic and exotic species may replace stress-tolerant species at the forest edge. Edge influence typically declines with distance from the non-forest area. The study sites were located in Riga, Latvia, in the hemiboreal vegetation zone. The aim of this study was to estimate the edge effect on the understory species richness in two Riga city urban forest tracts and to determine how species respond to abiotic factors and trampling. We hypothesized that the number and cover of herb species are higher on the edge, while the cover of typical boreal species (mosses and dwarf shrubs) is heavily affected by abiotic factors and trampling on the forest edge. The results of our research provide insight to the problem of urban forest fragmentation that leads to habitats loss in urban forest ecosystem.

Kiviste, Andres

The effect of thinning on survival of silver birch trees in Estonia

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Data from the Estonian Network of Forest Research Plots (ENFRP) was used to estimate the survival probability of silver birch trees (Betula pendula Roth). Several survival explanatory factors were fit into logistic models and then tested to determine the best ranking survival drivers. Different models with all possible combinations of explanatory factors were built and compared. After that, some thinning variables were defined and implemented to the best survival models to examine whether thinning practices could appropriately modify stand structure and density leading to higher survival rate. The outcome of this study showed that five-year diameter growth rate, id5, as a measure of tree vitality and tree relative diameter, drelative, as a measure of competition, or a combination of these two variables were superior to other explanatory variables in estimating the survival probability of silver birch trees. Additionally, the results of this study suggest that if thinning operation happened to take place amongst birch trees within the influence zone, it successfully declined the density to some extent, depending on the thinning intensity, letting light-demanding birch trees benefit from vigorous growth with less negative environmental interactions.

Kouhgardi, Esmaeil

Feasibility study for reuse of sewage of wastewater treatment plant of Genaveh Hospital for agricultural irrigation

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Reuse of sewage of treatment plants may be regarded as one of highly effective strategies for overcoming water scarcity-related problems. This research has been conducted, aiming at feasibility study for reuse of sewage of wastewater treatment plant of Genaveh Hospital for agricultural irrigation. Physicochemical, biological and microbial parameters such as pH, EC, calcium, magnesium, sodium, potassium, nitrite, phosphate, BOD5, TDS, TSS, fecal coliform and all coliforms with heavy metals, namely ferrous, manganese, nickel, cadmium, cobalt, zinc and copper in wastewater and sewage, have been specified within six months from August 2013 to January 2014 and then compared against WHO, EPA and FAO standards by using One Sample-Test method. The results revealed that the sewage treatment plant conforms to existing standards as compared to the standards for reuse in agriculture in terms of all parameters, except for BOD5 and COD in comparison with EPA standard and Nitrate, TSS and TDS and percentage of sodium and considering the parameters of EC and SAR and by using Wilcox diagram; the quality of sewage for irrigation belongs to Class C3S1 or average classification that can be suitable in case of proper granulation of farming land and water penetrability in soil.

Kriiska, Kaie

Forest belowground carbon cycle-linkages between soil respiration, fine root and litter production and decomposition rates in varying stand fertility and moisture conditions in Estonia

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Belowground processes play an important role in global carbon cycle through the regulation of soil carbon. Climate change, accompanied by increasing temperature and precipitation in the Boreal region is likely to alter soil fertility, accelerate SOM decomposition and decrease the amount of carbon stored. The aim of the current study was to analyse the variability of above- and belowground litter input, its decomposition and correlation with soil respiration in four spruce (Polytrichum, Myrtillus, Oxalis and Calamagrostis alvar) and four pine (Cladonia, Vaccinium, Myrtillus, Fragaria) stands with varying soil moisture and fertility conditions. The selected stands are ICP Forests and ICP Integrated Monitoring programme monitoring plots. As the main pathway of CO_2 transferred from soils to the atmosphere is through soil respiration, fine-root turnover rates were determined and the hypothesis that root turnover might be driving patterns in soil respiration was analysed. The aboveground/belowground litter ratio that reflects soil carbon accumulation was twice as high in spruce stands compared to pine stands. No significant difference was found in the decomposition of fine roots and litter between spruce and pine stands, however, needles decomposed twice as fast as fine roots in all stands.

Krisjane, Zaiga

Socio-ecological system in flux: A case study of the Engure coastal area

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Coastal areas are typically multi-use and unique systems shaped by natural and cultural landscapes. Latvia has experienced remarkable changes in political and socio-economic conditions following the demise of the Soviet Union. This affected the way how ecological and social systems were changed and how associated land use decisions were made. However, less is known about the local effects that altered coastal areas in Latvia. In this respect, one of the most intriguing ongoing debates questions the nexus between social and environmental change at sub-regional scale. In this case study, we address changing interactions between ecological and human systems by focusing on the transition in land use patterns in the coastal area of Engure. Besides, this area serves as a prominent and instructive laboratory for our analysis due to its suburban location, richness in natural amenities and evidence of rural restructuring. Moreover, the territory is set as a LTSER in Latvia. Our empirical analysis is based on data from the latest censuses and a survey performed among local residents. Using the Engure coastal area as an example, we show the role of post-socialist transition in terms of changing population composition, economic activities and land use patterns in contemporary ecological and social system.

Laarmann, Diana

Effects of restoration treatments on natural forest structures in Karula National Park, Estonia

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Silvicultural systems for timber production have impacts on ecosystem structure and functions associated with anthropogenic alterations of natural disturbance regimes. Modern forestry is based on understanding the processes of natural disturbances, their effects on stand development and landscape composition and structure, considering that this allows forest management to reduce negative impacts of timber harvest on biodiversity, and maintain ecological functions. Restoration is an activity which can improve quantitative and qualitative conservation efforts in protected areas, more specifically by establishing or replacing natural processes, structures and functions. The objective of this study was to assess the effects of restoration treatments implemented in 2000 in Karula National Park, Estonia. The collected data was used to analyze ecosystem's response to different treatments in comparison with the control areas and old-growth forest.

Lencinas, María

Monitoring variable retention harvesting in southern Patagonia *Nothofagus* forests using ground beetles as potential indicators

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Variable retention has been proposed to mitigate harmful effects of harvesting in southern Patagonian *Nothofagus pumilio* forests. We propose the use of ground beetle diversity as impact indicators due to their abundance and diversity. The objective was to determine the impact of two different retention methods on *N. pumilio* forests using ground beetles as biodiversity indicators. We sampled three areas under management across Tierra del Fuego (Argentina), including old growth (OG) and harvested stands, with aggregated (AR) and dispersed (DR) retention. We located 4 sets of pitfall traps (each set consisting of 5 traps) in each area, which were collected after a week during middle summer. We sampled 1437 individuals from 45 morpho-species of 16 families. Significant differences were found in abundance between areas and treatments, whereas species richness only changed between areas. The abundance was highest in OG, followed by AR and DR. Harvesting reduces the abundance of ground beetles (either AR or DR) but richness is more dependent on site location. Changes across landscapes make off-reserve conservation strategies necessary.

Lencinas, María

Spider assemblages in Tierra del Fuego landscapes and their impact on variable retention harvested forests

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Spiders are relatively unknown in South Patagonia, but potentially useful as bioindicators. Therefore, we evaluate spider assemblage at landscape level and their impact under forest management in Tierra Del Fuego. At landscape level we compare grasslands, peatlands, *Nothofagus antarctica* and *N. pumilio* forests, while under management we study primary (BP) and harvested *N. pumilio* forests, with aggregated (RA) and dispersed (RD) retention. We used pitfall traps in 6 replicas of each environment collected every 15 days during one summer. We sampled 524 individuals from 41 species (families *Linyphiidae*, *Mecysmaucheniidae, Anyphaenidae, Amaurobiidae, Zodariidae* and *Salticidae*), with more captures at the beginning of summer. Richness and abundance followed the pattern: *N. Antarctica* >*N. pumilio*>peatland>grassland and RD>BP>RA, with 18 species of forests, 16 of open environments and 3 generalists. In harvested forests, 7 species diminished abundance, 11 were new or increased, and 5 did not vary. Ordination at landscape level grouped forests split from open environments, while RA and RD overlapped distribution but RD had greater dispersion. Spider assemblage differed in landscape and under management, proving to be a good potential bioindicador of environmental conservation status.

Liepa, Liga

The persistence of edge effect on Fennoscandian deciduous swamp woods in Southern Latvia

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A major part of hemiboreal forest landscapes have been intensively managed during the last centuries. Woodland key habitats (WKH) have been established in Nordic and Baltic countries to preserve small forest parcels in managed and highly fragmented forest landscapes. However, this cost-efficient conservation tool is strongly affected by fragmentation, edge influence, isolation and habitat depletion. Few empirical studies have assessed how different taxonomic groups respond to the establishment of edges from silvicultural practices. We explore the influence of edges on vegetation, stand structural characteristics and occurrence of lichen indicator species in 30 Fennoscandian deciduous swamp woods in Southern Latvia. Additionally we investigated the persistence of edge effects in these stands. For this we compared WKH adjacent to young, middle-aged and mature stands within the distance of 0–50 m from edge to forest interior. We found the most pronounced differences in species composition, amount of dead wood and the occurrence of epiphytic lichen indicators between WKHs adjacent to young and mature forests. Our results suggest that WKHs adjacent to young stands are strongly influenced by silvicultural practices and therefore could not facilitate the survival of focal species.

Mainardes da Silva, Lenir Aparecida

Forest certification, traditional people and community rights

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In Brazil, wood production is a relevant activity since it is economically important, providing more jobs and income. In this case, wood production must take place in accordance with international laws such as ITO, ILO and other legislation practices and also respect traditional customs of local communities. An essential condition set by the Forest Stewardship Council – FSC - provides that wood production must bring better social and economic conditions to workers and their communities. In addition, this production must have respect for indigenous and riverside people, rubber tappers, babassu coconut breakers (women in general) and the use of the land. The local people have distinct collective identities in relation to cultural awareness about the local culture and traditions. In this sense, the local space has an ecological, spiritual and cultural meaning and has to be protected by people responsible for the production of wood. This paper aims at presenting some data concerning Brazilian social policy to protect people who live in these communities.

Morales, Claudia

Ethnobotany of firewood for domestic use in the community of Santa Lucia Lachuá, Alta Verapaz, Guatemala

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In Latin America for about 81% of rural population and urban low-income groups household firewood is an indispensable need. Due to its big importance for subsistence and the lack of modern and efficient energy services, the demand is high. Therefore it is important to recognize this fact appropriately and be aware of its implications in the management and conservation of energy resources. In the Mayan Q'eqchi' Community of Santa Lucia we investigated how the classification criteria and timber management are related to beliefs, knowledge and Mayan practices. Using semi-structured interviews and community workshops, attributes used to classify wood according to its effectiveness as fuel were identified. From the attributes identified, a cluster analysis and principal component analysis were performed to analyze the demand for firewood, which about 92% of families use as their sole energy source. 13 species of high importance were identified as well as five major attributes: durability, ember, ignition, ash and availability. Two attributes are highly used in the selection of wood (in their case ancient knowledge and personal experiences combine). Despite the selection criteria and knowledge of species, the availability and abundance of wood often matters more than other attributes.

Metslaid, Sandra

Forest productivity and growth variation on degraded post-mining landscapes: Assessment based on long-term observations

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Opencast mining of oil shale degrades a considerable area of landscape every year in Estonia. Attempts to recover economical and environmental values are mainly made through afforestation. Up to date, the area rehabilitated with forests exceeds 16 thousand hectares, increasing every year. Monitoring and gradual assessment of growth in such forests provides an important insight for decision-making in managing these natural recourses and for assessment of changes in the productivity of degraded lands. The aim of our study was to investigate growth variation and yield of forest stands of different tree species and to compare it with the growth of forest stands on forest sites. Based on the results of previous studies, we hypothesize that growth rates and productivity of forest stands of reclaimed areas are tree species specific, and that the growth of species demanding fertile substrate conditions may slow down despite a great performance in the early development stage. Our assessment is based on long-term monitoring data, which covers the time span from the stand establishment until 2014.

Motallebi, Azimeh

Height-diameter relationship in managed and unmanaged forest

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The most commonly described growth variables in trees are total height and diameter at breast height. Improved understanding of mentioned relationship is necessary for accurate quantification of regional and global forest stand characteristics, carbon storage, product quality, as well as for site index and succession. Silvicultural treatment, e.g. thinning, may have impact on stem slenderness and change this relationship. A data set was collected from 257 plots of the Estonian network of forest growth monitoring permanent plots which were established during the period of 1995–2004 and cover entire Estonia. We used 17 040 tree measurements, including three dominant tree species from thinned and unthinned stands in order to test the following hypotheses: H1) there are significant differences between tree height and stem diameter relationship in managed and unmanaged forest, H2) the management influence on height-diameter relationship is not dependent on tree species.

Napa, Ülle

Cd, Cu, Pb, and Zn concentrations and accumulation in soil organics and retention in fine roots of coniferous stands

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ICP Integrated Monitoring and ICP Forests programmes enable the quantification of fluxes and pools of heavy metals. We present the heavy metal (HM) input and uptake balances of 6 coniferous stands. Litterfall, soil organics, needles and fine roots were collected during 2009-2013. In addition deposition data of 18 stations of local precipitation network was used. The highest concentrations for Cd and Pb were in soil organics, the highest concentrations of bio elements (Cu and Zn) were measured in the second year´s fine roots. In fine roots the average concentrations were 5 times higher for Cd and Pb, 50 % for Cu and 30 % for Zn than in litterfall. The greatest HM concentration difference between living needles and litterfall occurred in regard to Pb, indicating a strong tendency to accumulate with needle age. The largest stocks of HMs were embedded in organic layer of soil, where regional differences in accumulation occurred for Pb, Cu and Zn. HMs like Cd and Pb are strongly bound to organic material – accumulating in organics of soil and retaining in fine roots and litterfall. Decomposition rate of root litter is low in comparison to litterfall, therefore HMs in older coniferous forests are released more easily and are more often taken back to cycling from litterfall than from fine roots.

Nigul, Kristi

Assessment of tree diameter distributions for describing structural legacies in hemiboreal forest in Estonia

Kristi Nigul, Ahto Kangur, Henn Korjus, Andres Kiviste, Diana Laarmann, Allan Sims, Marek Metslaid

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Järvselja primeval forest compartment (19.7 hectares) in Estonia can be considered as a model unit for understanding how different legacies have evolved. Different stand structures after several disturbances may lead to changing plant communities. This site is a good place for rare and susceptible plant species. Järvselja primeval forest has been unmanaged for over 90 years; it is interesting to see how undermanaged stand is influenced by various disturbances that have developed. We analysed tree stem size distributions in tree mapping data from a naturally developing forest ecosystem.Tree and stand structure measurements were conducted in 2013 and covered 8.78 hectares. We focus in the study on standing living and dead trees, lying trees and high snags. The measurements in the stands included besides the description of tree locations the decay stages for living and dead trees (5 decay classes), vitality (vital, poor, normal), dominance (co-dominant, subdominant etc.), tree layers, height (tree height, live crown base height and dead crown height), and diameter. Several earlier studies indicate that frequent disturbances in hemi-boreal forest result in a gradual change of species composition in favour of deciduous tree species. Järvselja data indicate a clear tendency to follow this trend.

Paluots, Teele

Assessing conservation value of forest ecosystems in Lahemaa National Park, Estonia

Teele Paluots, Henn Korjus

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Lahemaa National Park was established in 1971, being the first national park in Estonia. It represents and protects local nature and cultural heritage, typical and unique to North Estonia. It is also one of the most important forest conservation areas in Europe, included in Natura 2000 network. A large scale forest inventory covering 60% of Lahemaa National Park forests on more than 20, 000 hectares took place during 2009-2011. The inventory involved all national park management zones (nature reserve, special management zone, limited management zone) and consisted of forest survey and revaluation of Natura 2000 forest habitats. As expected, nature reserves turned out to be of highest value and oldest forest habitats. The representation of Dryopteris and minerotrophic mobile water swamp forest (Calla) site types is also remarkable in these areas. Special management zone forests are mainly dry boreal, boreal heath and ombrotrophic bog forests types, but seven different Natura 2000 forest site types in different value classes are also presented in these areas. Boreal forests dominate the limited management zones, but compared to special management zones there are not many boreal heath and bog forests. The more recent boreal and rich paludified forests are more numerously represented in lower value classes.

Pinto, Maria Alice

Spatial patterns of single nucleotide polymorphisms (SNPs) support a scenario of secondary contact in Iberian honey bees *(Apis mellifera iberiensis)*

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Dissecting diversity patterns of organisms endemic to Iberia has been truly challenging for a variety of plant and animal taxa, and the Iberian honey bee *(A. m. iberiensis)* is no exception. Surveys of genetic variation in the Iberian honey bee are among the most extensive for any honey bee subspecies. From these, differential and complex patterns of diversity have emerged, which have yet to be fully resolved. Here we used a genome-wide data set of 309 neutrally-tested SNPs, scattered across the 16 honey bee chromosomes, which were genotyped in 711 honey bee haploid males. These SNPs were analyzed along with an intergenic locus of the mtDNA to reveal historical patterns of population structure across the entire range of the Iberian honey bee. Overall, the patterns of population structure inferred from nuclear loci by the spatial principal component analysis (sPCA) were consistent with two major clusters bisecting Iberia along a northeastern-southwestern axis, a pattern that closely parallels that of the mtDNA. These findings support a scenario of secondary contact that probably results from expansions out of Pleistocene Iberian refugia. This study highlights the complexity of the Iberian honey bee patterns and reinforces the importance of Iberia as a reservoir of Apis mellifera diversity.

Saklaurs, Marcis

An assessment of water quality along riparian forests in Latvia – preliminary results

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Generally the ecosystem evaluation process is becoming increasingly important to investigate the role of riparian forests and their contribution to ecosystem services. Riparian forests are the transition zone between water and terrestrial ecosystems and they provide key functions for retaining and accumulation of pollutants and nutrients. In this study we investigated riparian forest stands adjacent to low, medium and good water quality streams. The characteristics of riparian forests were evaluated according to the amount of deadwood as well as vegetation composition, focusing on their impact on water quality. The aim of this study was to compare the costs of conventional water treatment to the benefits that forest stands provide in water purification. An ecosystem approach was used to evaluate the differences in the monetary value of riparian forest stands. This study demonstrated that there are interactions between forest stand characteristics in riparian forests and the level of water quality.

Schimanski, Edina

The connection between rural and urban spaces: Changes in the landscape and the consequences of pesticides for people from community in Brazil

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This study examines the ways that landscapes have been reconfigured in the region of Ponta Grossa – Parana – South of Brazil, and the consequences of pesticides for people who live near the junction between rural and urban areas. Historically, the expansion of cities has been marked by the logic center-periphery, and in the last decades, the transfer of groups of people has been noticed from the most central areas to the most peripheral ones. Because of this, a strong junction between rural and urban spaces has been observed, producing changes in the local landscape. The evidence shows that communities which are located near the junction of rural and urban areas are very close to large areas of crops (e.g. soybean), being therefore totally exposed to the pollution from the fertilizers used in those areas. Data collected from research shows that the families living in the areas are exposed to a routine of severe environmental, social and health problems without really understanding how serious the problem is. In this sense, it is necessary to identify ways to face the consequences of the use of fertilizers in order to stop pollution in the place.

Soler, Rosina

Agroforestry systems in different forest types of South America: Concepts, state of knowledge and recommendations

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To synthesize the state of knowledge on agroforestry systems in South America and to compare the research developed by country, we performed a literature review in seven countries (Argentina, Brazil, Chile, Colombia, Ecuador, Paraguay and Peru), referring to the components conforming agro-silvopastoral systems, the component under study, and recommendations. For each country we extracted 25 scientific articles and other information. 166 relevant articles were obtained from 1983 to the present, a few of which (11%) dealt with long-term (>5 years), compared with short-term (28%) or punctual studies (61%). The studies were conducted mainly on the wood component (45%), followed by agriculture (32%), social situation (17%) and livestock (7%). This was the case with all countries except Chile, which had increased focus on agricultural issues (43%). Our research aimed at productivity issues (41%) but also conservation (30%) and to a lesser extent restoration (17%) or social questions (13%). Finally, 73% included recommendations mostly orientated towards improving management (52%), but also conservation (25%) and policy (23%). This study demonstrates the growth of research in agroforestry systems in South America and the generation of scientifically based recommendations, also the importance of forestry in the region.

Tomson, Pille

The contribution of former slash and burn fields to forest biodiversity

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Slash and burn cultivation lasted in Southern Estonia until the end of the nineteenth century. The land used for fire cultivation for centuries was no longer suitable for modern agriculture; most of these sites are now covered by forests. Historical maps from the nineteenth century enable to identify the location of former slash and burn areas.The study was carried out in Karula National Park and Haanja Nature Park in Southern Estonia in 64 mature forest stands (35 former slash and burn sites and 29 old forest stands). 42 % of the observed slash and burn sites and 76% of the old forest stands were designated as Natura 2000 habitats (9010*, 9050, 9060). Signs of forest felling were present in 73 % of slash and burn sites and in 64 % of old forest stands. The basal area of dead trees, the amount of lying trunks as well as that of high natural stumps were larger in slash and burn sites. The number of uprooted trees was larger in old forests. Large outstanding individual trees are characteristic of slash and burn sites.The results demonstrate that former slash and burn sites are comparable with old forest stands in their contribution to biodiversity in terms of forest structural elements. The conservation value in terms of species composition will be the subject of future analyses.

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