IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Are fragmented landscapes colder in winter?

Christopher Latimer, University of Wisconsin-Madison; Benjamin Zuckerberg, University of Wisconsin-Madison*

Land use and land cover change can interact with weather and climate to create fine-scale (<2km) variation in abiotic conditions (microclimate). In forested landscapes, microclimate variability captured over hundreds of meters can often exceed warming estimates predicted by future climate change scenarios, thereby creating unique opportunities for organisms to interact with and respond to climate variability at a microscale. Little is known about what landscape-scale features contribute to microclimate variability in human-modified landscapes, and whether or not this variation is ecologically relevant for vagile organisms like wintering birds. Here, we test the hypothesis that highly fragmented landscapes are colder during winter and present greater energetic challenges to wintering birds than less fragmented landscapes. We found considerable variation in minimum daily temperatures driven by percent forest cover in the surrounding landscape (1 km) and forest patch shape complexity, suggesting both landscape composition and configuration are important determinants of local abiotic conditions. Elevation and physiographic position on the landscape contributed little to microclimate variation, implying these factors are of lower importance to microclimate variation in topographically simple landscapes. Lastly, we found that extremes in microclimate variation can equate up to 25% savings in daily energy expenditure for wintering birds across the study region. Understanding the causes and consequences of microclimate variation will inform conservation efforts that can reduce potential exposure of target species to future climate warming through manipulation of landscape composition or configuration, or by identifying preserves in areas most likely to harbor favorable climate conditions.

Urban landscape ecology: A retrospective and prospective overview

Jianguo Wu, School of Life Sciences and School of Sustainability, Arizona State University and Center for Human-Environment System Sustainability (CHESS), Beijing Normal University

Cities have been the centers of economic and social developments, as well as sources of many major environmental problems. Cities are created and maintained by the most intensive and extensive human-nature interactions. Urban areas, from small towns to metropolitan regions, are all landscapes predominantly patterned by human activities. The future of humanity will increasingly rely on cities, and the future of landscape ecology will inevitably be more urban. To meet the grand challenge of our time - sustainability - cities must be made sustainable and, to this end, landscape ecology has much to offer. In this presentation, I discuss the intellectual roots and recent developments in urban landscape ecology, and propose a framework for helping move it forward. This framework has a triadic structure, integrating patterns, impacts, and sustainability of urbanization and embracing perspectives from landscape ecology, urban ecology, and sustainability science.

Nature or agriculture - a study of drivers of farm-level land use change in a peri-urban landscape

Dr. Anne Gravsholt Busck, University of Copenhagen; Dr. Soren Bech Pilgaard Kristensen, University of Copenhagen*

Peri-urban landscapes are dynamic landscapes, characterized by a multitude of interests and drivers of landscape change. They are strategic landscapes from a planning perspective, as they offer important recreational and residential services to urban regions. While they may present a traditional agrarian appearance, urban proximity gives rise to greater diversity of land use, residents and stakeholders than we find in other areas. Farm-level landscape decisions are therefore expected to be influenced by a distinct set of drivers and therefore traditional policy instruments (eg. agri-environmental subsidies)

may have unexpected or low performance. More information is needed about the drivers of landscape change at farm level in peri-urban landscapes. To this end, we investigated drivers behind land use changes in Roskilde Municipality, Denmark, a peri-urban landscape with a high level of landscape dynamics. The research focused on the motives and factors behind landowners' decision-making in relation to land use changes, to improve our knowledge of the dynamics of land use change processes. An actor-centred conceptual framework was developed on the basis of the concept of "lenses of decision-making"(Farmar-Bowers & Lane, 2009). Data on farm and farmer characteristics were collected through a survey with 93 landowners and a logistic regression analysis was used to reveal relationships between selected farm and farmer characteristics and the landscape activities. Secondly, cluster analysis was used to analyse patterns of motives associated with land use changes. We found that intrinsic interests and family considerations were key motives for land use changes in addition to a desire to improve the qualities of the property.

Testing ecological theory and revealing local-scale vegetation dynamics using legacy data, land survey records, and phytoliths

Jenny L. McCune, University of Guelph; Marlow G. Pellatt, Parks Canada; Mark Vellend, Universite de Sherbrooke*

Widespread human disturbance has created fragmented plant communities surrounded by urban and agricultural land use. Predicting how plant communities will respond to these landscape changes is difficult given potential time lags in plant community response and uncertainty about the historical range of variability in the past. We use a historical ecological approach to test ecological theory and investigate local-scale variability of the oak savannah and conifer forest-dominated landscape of southeastern Vancouver Island, Canada. First, we use legacy data from the late 1960s combined with resurveys of the same plots to test whether colonizations and extirpations over four decades are predictable based on landscape context and plant traits. Then, we combine early land survey records with current vegetation surveys and the soil phytolith record to determine the historical range of variability on a local spatial scale prior to European colonization in the mid-1800s. Our results show that plant community change on this landscape is predictable based on plant traits, but this change is largely driven by colonization events. Extirpations are less common and much less predictable. The soil phytolith record suggests that the degree and timing of historical shifts from open savannah to coniferous forest differs between local sites within a regional landscape that appears relatively stable. A greater understanding of how the vegetation has changed in the past can inform both ecological theory and ecological restoration.

How agriculture and land degradation created nature - the rise and fall of xeric sand calcareous grasslands in southern Sweden.

Joachim Regnell, Kristianstad University; Magnus Thelaus*, Kristianstad University; Henrik Svensson, Kristianstad University; Sten Skansjo, Kristianstad University*

We analyse drivers of landscape ecological change to understand biodiversity dynamics linked to land use and land degradation in dry, sandy areas in southern Sweden. We integrate methods from natural and social sciences including physical, pollen and radiocarbon analysis, dating of dune stratigraphy by OSL and historical maps and written sources. Xeric sand calcareous grassland is a habitat in serious danger of being extinct. Its origin goes back to an agrarian expansion during early Medieval Time in connection with land use based on area-extensive agriculture including long fallow periods retaining CaCO3 in the topsoil. Grasslands decreased during agrarian regressions correlated to climatic deterioration and the Black Death. More stable conditions promoted leaching of the topsoil leading to

acidification. The habitat became prosperous once again during the 17th-19th century caused by deforestation and a second expansion of agriculture and grazing resulting in major land degradation, sand drift, loss of fertile top soil and inland dune formation. It is likely that wind erosion counteracted topsoil depletion by exposing CaCO3-rich sand. This second event is correlated to the last part of the Little Ice Age. By the 19th century much of the area was reforested with pine plantations to overcome the severe erosion problems. Today, environmental management including topsoil removal and soil perturbation is applied to restore and maintain the xeric sand calcareous grasslands in limited areas.

Towards a tipping point for fuel management: implications for forest restoration and wildfire dynamics in a multi-ownership landscape.

Ana M.G. Barros , Oregon State University, College of Forestry; Alan A. Ager, USDA Forest Service, Pacific Northwest Research Station, Western Wildland Environmental Threat Assessment Center; Michelle Day, Oregon State University, College of Forestry*

Agent-based models (ABM) allow users to examine the long-term effects of agent decisions in complex systems where multiple agents and processes interact. This framework has potential application to study the dynamics of coupled natural and human systems where multiple stimuli determine trajectories over both space and time. Here, we describe the application of Envision, a landscape based ABM, to analyze long-term wildfire dynamics on a 3.2 million ha fire prone landscape in Oregon, USA. Specifically, we use the model to examine whether a tipping point can be detected in terms of a stable change in wildfire occurrence and burned area in response to specific rates and patterns of fuel management that are common practice in the study area. We first integrated the semi-empirical Minimum Travel Time (MTT) fire spread algorithm into Envision and then built a fire prediction system based on the historical (1992 - 2013) fires within the study area. We then simulated six alternative fuel reduction scenarios that varied in treatment type and rate over a 30-year period and examined the response in wildfire activity in terms of both variability and mean annual area burned. Vegetation dynamics and fire effects were modeled using a state and transition model developed as part of the larger Forest People Fire project described in other talks in this session. The results illustrated possible future wildfire scenarios and fire regimes under different fuel management strategies. The outputs can be used by land managers to inform the development of long-term restoration strategies.

Part I: Using geospatial techniques to characterize landscape dynamics across multiple spatial scales; Introductions: Outline of the session and expectations

Henry N. N. Bulley, Borough of Manhattan Community College, City University of New York

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Spatial conservation planning and climate uncertainty

Glenn Guntenspergen, U.S. Geological Survey; Jennifer Olker, University of Minnesota-Duluth; Amy Ando, University of Illinois; Minday Mallory, University of Illinois; Jennifer Fraterrigo, University of Illinois*

Conventional conservation planning paradigms that incorporate information about the current spatial distribution of ecosystem properties need to be reexamined under future climate scenarios because the uncertainty associated with future climate may cause uncertain changes in the spatial distribution of ecological conditions. We examine this issue by assessing changes in the spatial variability of wetland conservation status across the Prairie Pothole Region (PPR), a 750,000 km2 area in central North America. We used the wetland ecosystem model WETLANDSCAPE (WLS) to simulate the spatial effects of climate change on wetland status in model experiments using eight different downscaled climate

projections run to 2100. Spatial trends in wetland conservation status, as expressed by wetland cover-cycle dynamics (CCI) corresponded closely to the strong northwest southeast climate gradient across the region. CCI values changed ten-fold across the PPR and the slope of the response range varied from -0.6 to 0.4 with non-linear responses in some areas of the PPR. However, CCI values did not exhibit the same spatial pattern using downscaled climate scenarios compared to historical responses to climate. We then discuss the potential use, by managers and conservation groups, of risk management tools from financial portfolio theory to exploit the spatial covariances in projected ecological conditions from WLS model output to spatially target mitigation, restoration, and adaptation investments in ways that minimize uncertainty for a given level of expected conservation benefit.

Comparative analyses of urban ecosystems- lessons from Australia

Amy K. Hahs, Australian Research Centre for Urban Ecology, Royal Botanic Gardens Melbourne; Mark J. McDonnell, Australian Research Centre for Urban Ecology, Royal Botanic Gardens Melbourne*

Cities are highly dynamic places. Patterns observed today may not have arisen from the same drivers that form patterns in the future. Similarly, the important drivers may not be consistent between other contexts. Understanding how the demographic, cultural and physical features of cities change over time, and the impacts that these changes have on patterns of biodiversity, has important implications for urban landscape ecology. Australia is a country with a renowned diversity of native plants and animals, and high levels of endemism occur at multiple spatial scales. It is also a country with a relatively recent history of urban development, yet already 64% of the population lives in five cities. Recent and rapid urbanisation in highly diverse natural ecosystems are also characteristics shared by many southern hemisphere cities in Africa and southern Asia. Therefore, Australia provides a key opportunity to test how applicable the northern hemisphere findings are in cities with contrasting development histories, climatic conditions and species assemblages. Australian cities also provide a potential model for identifying which actions are most effective in guiding future sustainable urban development in highly diverse landscapes. A comparative ecology approach allows us to better understand the important drivers acting in urban landscapes, and how they may change over time or across different contexts. This understanding is critical if we are to develop urban planning and management tools that are flexible enough to adapt to current conditions, without compromising future options for biodiversity conservation.

Use and Interpretation of Human Disturbance Gradients for Condition Assessment in Great Lakes Coastal Ecosystems

Lucinda B. Johnson, Natural Resources Research Institute, University of Minnesota Duluth; J. David Allan, University of Michigan; Meijun Cai, Natural Resources Research Institute, University of Minnesota Duluth; Nicolas Danz, Department of Biology, Unive*

The Laurentian Great Lakes and its basin are impacted by multiple stressors that range from chronic to pulse in their temporal dimension and local to regional in their spatial dimension. Successful restoration across a region requires comprehensive data capable of depicting stress types and sources, permitting evaluation, planning, and execution. Two projects (Great Lakes Environmental Indicators (GLEI) and Great Lakes Environmental Assessment Map (GLEAM)) have recently characterized human activities across the Great Lakes Basin. The Coastal Wetland Monitoring Program developed a disturbance gradient to represent localized sources of stress, which includes water quality as well as landscape data. These stress gradients were derived from multiple spatial data describing anthropogenic stressors; each has appropriate uses for predicting stress and establishing stress-response relationships. We will discuss

characteristics of each, examine concordance in areas of overlap, and discuss appropriate uses of each gradient.

Recolonization of the New Zealand sea lion (Phocarctos hookeri): using Maxent to identify suitable breeding habitats for management

Veronica F. Frans, Dept. of Systemic Conservation Biology, Georg-August-University Gottingen; Amelie A. Auge, School of Surveying, University of Otago, and South Atlantic Environmental Research Institute; Jan O. Engler, Zoological Researchmuseum Alexande*

The New Zealand sea lion (NZSL; Phocarctos hookeri), formerly found throughout mainland New Zealand, has undergone a severe shrinkage in distribution. Similar to other recovering pinnipeds, it is possible for the NZSL to return to a non-threatened status upon successful recolonization of formerly inhabited habitat. However, sites where NZSLs could reestablish themselves have yet to be identified and this could lead to proactive management and education to facilitate the recolonization process. Here, we modeled suitable breeding habitats for potential recolonization on mainland NZ using Maxent, based on female NZSL occurrences from one of its largest remaining breeding colonies. Females change terrestrial habitat preferences along three phases of inland movement during the breeding season. We modeled each phase separately and combined them afterwards. Finally, we developed a multi-criteria analysis from expert opinion to avoid areas of potential human impacts.
Maxent identified up to 787 suitable sites for â‰¥ 125 individuals. We reduced these sites to a minimum of 97 when accounting for human impacts and visual inspection. Model performance was excellent according to AUC values. Responses to habitat features were mostly similar to findings in literature.
This study offers several insights for management: (1) the suitability maps can be used as a prediction of where the NZSL could potentially recolonize; (2) the maps can highlight where potential interactions or threats to other species of concern could occur; and (3) results on limiting factors could be used for site management when landscape modifications are necessary to increase a siteâ€™s suitability.

Trans-Border Groundwater Aquifer Contamination and the Impact of Landscape Pattern: A Case Study in the Abbottsford-Sumas Aquifer

Tanya Gallagher, University of British Columbia ; Sarah Gergel, University of British Columbia*

Landscape patterns have an array of impacts on the ecological and hydrologic dynamics of aquatic systems, including many which span international boundaries. In the case of groundwater aquifers, agricultural land use patterns and practices are among the factors responsible for elevated nitrate concentrations. Landscape patterns can vary greatly across different political jurisdictions which can be especially problematic for managing contaminants in cross-border water resources. Further, coordination of landscape monitoring across political boundaries is challenging. To inform this monitoring gap, we examined the Abbotsford-Sumas Aquifer (ASA) which spans the US-Canada border (between British Columbia and Washington) and provides drinking water for over 100,000 people. Long-term studies of the ASA indicate elevated nitrate concentrations may be influenced by overlying land use. To understand how landscape patterns differ across the region, we asked: (1) How have landscape patterns in the ASA changed in the last 25 years? (2) Do landscape patterns differ north and south of the border? A variety of USA and Canadian geospatial datasets were used to create 5 seamless cross-border land cover layers in 5 year increments from 1990 - 2015. Configuration (percent agriculture, forest, etc.) and composition metrics (patch size, patch density, etc.) were quantified using Fragstats. Changes in landscape patterns over time were compared between the USA and Canada. Clear differences in farm

size and land cover were identified. This work is the first step in understanding impacts landscape patterns have on regional groundwater quality and will help develop a suite of monitoring approaches useful for trans-border water resources.

Distribution and Prediction of Human Cases of Spotted Fever Group Rickettsia and Lyme Disease in North Carolina and Virginia

Austin J. Harner, Appalachian State University; Steven W. Seagle, Appalachian State University*

Human risks of zoonotic disease often represent a complex interaction of distribution and abundance of cryptic vector species, fluctuating populations of mobile animal hosts, and variation in human use of fragmented landscapes. Tick-borne diseases of the southeastern United States incorporate each of these interacting factors. One of the most widely available databases that can lend insight to tick-borne disease risk is human case data. The objective of this research is to develop a regional (North Carolina and Virginia), county-level model to predict human cases of two tick-borne bacterial diseases - Rocky Mountain spotted fever (more generally spotted fever group rickettsia) and Lyme disease. Human case data from each county in NC and VA was mapped to examine spatial pattern of occurrence. To relate the distribution of human cases to factors that can determine distribution of tick species, human cases were predicted from multiple environmental variables representing temperature, rainfall, humidity, and land cover. Lyme disease is concentrated in northern VA, patchily distributed southward, and of low occurrence in NC. This distribution is weakly correlated with environmental variables, suggesting a biotic basis of distribution and spread. In contrast, spotted fever is widely distributed across both states but with clear foci of human occurrence. Environmental variables still explain only part of this variation. Results from this study provide a context and direction for ongoing sampling of tick species distribution and infection rates which, in addition to environmental variables, should increase ability to predict human risk.

Toward a complete dispersal kernel for a coral reef fish: demographic patterns, evolutionary consequences, and conservation implications

Cassidy D'Aloia, Boston University; Steve Bogdanowicz, Cornell University; Robin Francis, University of California at Santa Barbara; John Majoris, Boston University; Rick Harrison, Cornell University; Pete Buston, Boston University*

Quantifying an empirical dispersal kernel for any marine species has been a major goal of marine ecology for decades. Dispersal kernels are key to understanding connectivity, population dynamics, and divergence within metapopulations, and to optimizing the design of marine reserve networks. Here, we present the first marine dispersal kernel that extends deeply into the tail of the kernel for the Caribbean reef fish Elacatinus lori. We sampled adults (n=3031) and settlers (n=4110) along a linear transect that was designed to capture potential dispersal trajectories up to 30 km from source using genetic parentage analysis. We described the pattern of dispersal by fitting alternative probability density functions to the data. Next, we used generalized linear models (GLMs) to identify covariates of successful dispersal, and assess the predictive skill of the best-fit model. Finally, we used the model to predict demographic and genetic exchange across the entire Belizean reef and within the existing network of marine protected areas. We found that the probability of dispersal declines exponentially and approaches zero by only 16 km from source. Notably, pelagic larval duration and other biological covariates were not associated with the distance a larva travels. The GLM had strong predictive skill; its predictions regarding the emergence of spatial genetic structure were congruent with prior observations, suggesting that the model captures longer-term evolutionary dynamics. Finally, we show

that the existing network of marine reserves in Belize is not connected for this species, or other species with similarly restrictive dispersal kernels.

Human and climatic influences on the fire regime of the West African tropical forest

Francis K. Dwomoh, Geospatial Sciences Center of Excellence, South Dakota State University; Michael C. Wimberly, Geospatial Sciences Center of Excellence, South Dakota State University*

The West African tropical forest (referred to as the Upper Guinean forest, UGF), is a global biodiversity hotspot providing vital ecosystem services for the region's socio-economic and environmental wellbeing. However, it has become one of the most fragmented and human-modified tropical forest ecosystems. The most significant original forests left in the region are those in protected areas (PAs). We hypothesize that, human impacts and climate interact to drive spatial and temporal variability in fire, with fire exhibiting distinctive seasonality and sensitivity to drought in areas characterized by different population densities, agricultural practices, vegetation types, and levels of forest fragmentation. We analyzed TRMM rainfall datasets and MODIS active fire and burned area products to identify the influences of drought indices and other antecedent climatic indicators on temporal patterns of fire activity. Results were compared across sub-regions with different intensities of human land use to test for interactions between climatic and human influences on the fire regime. Increasing trends of population growth and agricultural expansion have significantly influenced landscapes in the UGF. The pattern of fire seasonality varied geographically, reflecting both climatological patterns and agricultural practices. There was a stronger response of fire to drought in sub-regions where human ignition sources and forest fragmentation and degradation have increased the vulnerability of PAs to fire. These results provide a more comprehensive characterization of the fire regime in the UGF and expand our understanding of the spatio-temporal dynamics of tropical forest fires in response to forest fragmentation and climatic variations.

Relative effects of dispersal ability and landscape heterogeneity on adaptive evolution in complex landscapes

Erin L. Landguth, University of Montana Norman Johnson, University of Massachusetts

Adaptive evolution is influenced by the interactive effects of natural selection, gene flow and drift, yet little is known about how these processes interact in spatially complex landscapes. Most actual populations inhabit landscapes where spatial patterns of population density vary across space and in which there are often differential patterns of selection. In this paper we used a spatially explicit, individual based simulation model to investigate the interactions between a range of dispersal abilities and a range of spatial patterns of selection. Our analysis is the first that we are aware of that quantify the interactive effects of selection, drift and gene flow in complex environments and the results indicate large roles of both the strength of selection and its spatial pattern on the evolution of reproductive isolation.

Contribution of annual crops vs. semi-natural habitats to landscape connectivity for different types of carabid beetles communities.

Stephanie Aviron, INRA SAD-Paysage; Sylvain Poggi, INRA UMR 1349 IGEPP; Nicolas Parisey, INRA UMR 1349 IGEPP; Remi Duflot, INRA SAD-Paysage & UMR Ecobio; Hugues Boussard, INRA SAD-Paysage; Etienne Lalechere, INRA SAD-Paysage & IRSTEA LISC*

Habitat connectivity is crucial for maintenance of biodiversity in agricultural landscapes. The effects of connectivity related to semi-natural habitats have been well documented, but the role of connectivity

related to cultivated covers is less explored. In this study we investigated the effects of connectivity related to cultivated and semi-natural habitats at different spatial scales on carabid beetles. Carabid communities were sampled in 27 1kmÂ² landscapes in western France and distinguished according to habitat specificity of species (woody habitat, grassland, maize, winter wheat). Analyses combining random forest algorithms and generalized linear mixed models were applied to test the effects of several landscape descriptors on carabid abundances for the different communities. Our results show that abundances of maize species increased with increasing connectivity between winter cereals and maize crops (in a 500m radius), which might reflect resource complementation processes between these crops. We also found antagonistic effects of woody habitat connectivity, i.e. negative effects on maize species abundances at large scales (in a 500m radius) vs. positive effects on woody species at finer scales (in a 50m radius). This suggests that enhancing forest and crop carabid species cannot be achieved through the only promotion of woody habitat connectivity in agricultural landscapes.

Prevalent multi-scale mismatch between urban sprawl and landscape fragmentation patterns creates windows of opportunity for conservation

Aurora Torres, Museo Nacional de Ciencias Naturales - Spanish National Research Council; Jochen A.G. Jaeger, Concordia University Montreal; Juan C. Alonso, Museo Nacional de Ciencias Naturales - Spanish National Research Council*

Urban sprawl and expanding transport networks drive landscape change and intensify land competition. They often affect ecosystems and human societies through synergistic processes, but our understanding of the complex ways in which these drivers interact is still poor. Landscape fragmentation, for example, is a major effect of the interactions between urban development and transport infrastructure expansion. Therefore, we assessed the strength, non-stationarity, and scale-dependency of the relationship between landscape fragmentation and urban sprawl patterns (sprawl-fragmentation relationship). We used spatially explicit quantifications of sprawl and fragmentation for Peninsular Spain, covering large gradients of sprawl and fragmentation. We fitted global regression models and geographically weighted regression models with different urban sprawl metrics and across multiple scales. We found that most variation in landscape fragmentation (about 80% on average) is not explained by urban sprawl metrics, and the effects of urban sprawl patterns on landscape fragmentation patterns vary locally and among scales. This raises the question of why the sprawl-fragmentation relationship is not as strong as expected. We propose four mismatching forces: time-lagged responses, spatial arrangement of development, scale-dependency of the relationship, and the contribution of external variables. These mismatches offer important opportunities for landscape conservation.

Question & Answer with Audience of Morning Session

Sadahisa Kato, Ibaraki University

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Identifying crop fields in need of more pollinators: a cost-benefit analysis of wild bee habitat enhancements in diverse landscapes

Eric Lonsdorf, Franklin and Marshall College; Claire Brittain, UC Davis; Neal Williams, UC Davis*

Wild bees provide pollination services that benefit many crops. However, agricultural landscapes are often lacking in habitats with consistent floral and nesting resources to support wild bees. Establishing such habitats in agri-environments may not only conserve and support bees but also benefit crop production. However, investing in bee habitat may not always pay off for a farmer. To differentiate

pollinator-limited landscapes that would benefit financially from enhancements from those that would not, we combine a landscape model of bee abundance with a cost-benefit analysis of establishing and maintaining bee habitat (wild flower plantings) along crop borders. Using watermelon as an example crop, we find that as the pollinator habitat quality of the landscape surrounding a farm increases, the financial benefits decline and ultimately become negligible. Furthermore, as the field size of the crop increases, the need for pollinator enhancement increases. This analysis represents a core process that could be used to provide decision support for identifying landscapes that would benefit most from habitat enhancements for crop pollination. Growers and managers for any crop and bee combination could use this approach where data are available to parameterize the models. As we move towards the broader use of habitat enhancements in agricultural landscapes, this method of evaluation gives the ability to methodically compare different landscapes to help guide adoption.

Impacts of imputation uncertainty and scaling on the estimation of forest attributes in a western Oregon, USA landscape

David M Bell, USDA Forest Service Pacific Northwest Research Station; Matthew J. Gregory, Oregon State University; Heather M. Roberts, Oregon State University; Janet L Ohmann, Oregon State University

Imputation methods provide high-resolution vegetation attribute layers needed to guide forest management and facilitate forest landscape modeling, but imputation uncertainty, especially at fine-scales, can be a major challenge. In this study, we explored the uncertainties in imputed maps produced using gradient nearest neighbor (GNN) imputation and the consequences of this uncertainty as estimates were aggregated (i.e., averaged) to coarser spatial resolutions for portions of the Coast Range of western Oregon, USA. While there are many imputation methods, GNN, which integrates field plot data, mapped environmental data, and Landsat imagery to map vegetation to each 30-m pixel, has been widely used in this region for vegetation monitoring. A bootstrapping implementation of GNN was used to assess uncertainties in mapped predictions from 30-m to 10-km pixel resolutions. Biogeography and disturbance not only impacted vegetation pattern at a variety of scales, but also uncertainties in imputed maps characterizing those patterns. Fine-scale (i.e., 30-m pixel) imputation variability was greater for community composition and dead wood variables compared to live tree structure (e.g., canopy cover and tree size) and varied regionally with respect to environmental gradients. By aggregating bootstrapped estimates up to coarser-resolutions, we found that variability, skewness, and kurtosis in predictions declined as pixel-size increased, though spatial variation in imputation variability remained high. Disturbances, such as timber harvest and fire, contributed to locally high uncertainties. The degree of aggregation necessary to produce predictions appropriate for decision making and ecosystem modeling depends not only on the variable in question, but biogeography and disturbance patterns.

The Trade-off Analysis of Ecosystem Services in Different Scales

Bojie Fu, Lu Nan, Zhenmin Zhen, Xiaoqing Jia State Key Laboratory of Urban and Regional Ecology, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing, China*

Ecosystem services are increasingly recognized as the foundations of a well-functioning society. Trade-off is defined as a situation where one ecosystem service increases while another decreases. In a broader sense, trade-off also refers to unidirectional changes with uneven paces or rates in ecosystem services. Although trade-off analysis for multiple ecosystem services is more integral for ecosystem assessment and management, studies regarding trade-offs are rare in the literature, especially at the landscape and regional scales. Large-scale ecological restoration projects have been implemented around China with the goal of restoring and sustaining ecosystem services. The relationships among

ecosystem services are often driven by land-use changes. We selected the China's Loess Plateau as the study area, which has experienced a large-scale Grain for Green Project and developed the applicable methods of ecosystem services trade-off to explore the relationships between ecosystem services in site, landscape and regional scales. Our findings suggest that quantifying the interactions between ecosystem services may improve the ecosystem-based management practices and support policy-making to address the challenges of the sustainable use of natural resources. The framework designed for landscape and regional-scales analysis can help in clearly understanding the interrelations of ESs and make natural resources related decisions more effective and efficient.

Carbon Sinks in Managed Temperate Coniferous Forests under Climate Change

Caren Dymond, Government of British Columbia; Sarah Beukema, ESSA Technologies; Craig Nitschke, University of Melbourne; David Coates, Government of British Columbia; Robert Scheller, Portland State University*

Forests are priorities for addressing climate change because while they are natural carbon sinks, mal-adaptation may turn them into net carbon sources. Management activities can potentially increase the magnitude of forest-based carbon sinks while also facilitating adaptation of forests to new climatic conditions. Understanding the potential impacts of climate change on the productivity and forest carbon dynamics is one way to support management decisions around adaptation. In this study we simulated the Pine Creek valley in north-west British Columbia using the Forest Carbon Succession module of the landscape simulation model LANDIS-II. The model simulates growth, competition, and decay dynamics of above- and below-ground carbon pools and integrates fire and harvest disturbance extensions within the LANDIS-II family. The projections of impacts on productivity and carbon sinks were: positive for higher elevation forests where tree species were able to capitalize on warmer conditions and longer growing seasons but disturbance rates remained constant; negative for lower elevation forests where productivity declines but the harvest rate is higher and fire risk is higher compared to other parts of the landscape; and, negligible in mid-elevation forests. Forest carbon dynamics were found to be highly influenced by disturbance regimes. There may be opportunities for forest managers to increase productivity and carbon sinks at lower elevations by planting species or genotypes from warmer locations within the region.

Next steps in Food & Forest Research: Open Discussion and Brainstorming session. All Welcome.

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An early-warning tool for forecasting dynamic fire hazard across sensitive arid landscapes in North America

Luke J. Zachmann, Conservation Science Partners, Inc.; Miranda E. Gray, Conservation Science Partners, Inc.; Brett G. Dickson, Conservation Science Partners, Inc.*

The arid and semi-arid landscapes of North America are increasingly impacted by changing fire regimes. A primary cause entails altered fuels driven by plant invasion and land use practices such as overgrazing and fire suppression, while consequences involve vegetation type-conversion, alteration of wildlife habitat, and biodiversity reductions. The drivers and subsequent effects of wildfire cut across both scales and administrative boundaries, and create substantial challenges for land managers. We used Google Earth Engine and MODIS burned area products to identify consistent characteristics of

vegetation and meteorology prior to fire occurrence. Additionally, we evaluated vegetation change post-fire. The spatially and temporally extensive archive of remotely-sensed data and computational resources of the Earth Engine platform enabled us to conduct the analysis for four major deserts (i.e., the Great Basin, Mojave, Sonoran, and Chihuahuan Deserts) and across the US-Mexico border. Utilizing more than a decade of data representing 50K square-kilometers of burned area, we found significant differences between burned and unburned areas in all four deserts, though the precursors of fire were unique between and within these ecologically distinct deserts. Compared to unburned areas and pre-fire conditions, we also found evidence of fire effects on vegetation, which could indicate type-conversion from native communities to systems dominated by fire-tolerant species. The near real-time availability of data allows rapid deployment of analytical products to serve as early-warning indicators of fire hazard, which can be used by land managers to monitor and manage fire and invasive plants in increasingly dynamic and vulnerable systems.

Transforming the EU Mediterranean landscape matrix: reversing rural abandonment to reinforce large scale resistance to wildfires

Nuria Aquilue, Centre d'Ã‰tude de la Foret, Universite du Quebec Ã Montreal; Marie-Josee Fortin, Department of Ecology and Evolutionary Biology, University of Toronto; Christian Messier, Universite du Quebec en Outaouais; Lluis Brotons, Center of Mediter

In the European Mediterranean basin, wildfires burn ca. 500 000 ha of forests and scrublands annually; eventually causing losses of human lives, and compromising ecosystem services and goods provisioning. Regional climate, topography, and vegetation water-stress alone do not drive fire ignition and spread, but emerge from complex multi-scale interactions among land-cover, fuel load spatial distribution, and human activities. While fire suppression policies are still the focus of scientific and public debates, we propose fragmentation of continuous vegetation-cover matrix by agriculture-conversion as an alternative, complementary option to reduce fire-prone ecosystems' exposure and vulnerability to large fires. Adopting a socio-ecological system approach we coupled a fire-succession and a land-use change spatially explicit model. The MEDFIRE landscape dynamics model simulates ecological processes driving vegetation dynamics under climate-driven fire regimes, while the MEDLUC land-use change model adopts a demand-allocation approach to modify the overall landscape composition by different land-use transition processes. We investigated the effects on fire regime when combining fire suppression and fuel-continuity management strategies under two climatic severity scenarios. Agriculture conversion allocation fragmented the landscape following a sparse versus a clustered pattern of change. Forecasts over 50 years in Catalonia (NW Spain) indicated that burnt area reduction was especially significant when applying both strategies, but not under more severe climatic conditions; and land-use changes scattering provided opportunities to decrease fire spread. Results suggest that novel strategies are required to infer fire resilience to Mediterranean forest ecosystems in the face of shifting fire regimes towards increasing fire frequency and intensity.

Future renewable energy opportunities: case Switzerland

Nica Huber, WSL; Rico Hergert, WSL; Bronwyn Price, WSL; Christian Zach, WSL; Marco Putz, WSL; Felix Kienast, WSL; Janine Bolliger, WSL*

We provide a spatially explicit assessments of renewable energy potentials and resulting implications under various scenarios of future land-use change in Switzerland. We also identify potential conflicts between stakeholders and outline regional-economic impacts of renewable energies. First, we provide a comprehensive and spatially explicit assessment on current and future renewable energy potentials for wind and solar given expected technological advancements and considering conflicts with different

stakeholders (tourism, nature conservation, provisioning services such as forest and agriculture). Secondly, we subject the renewable energy potentials to a rigorous sensitivity assessment using various scenarios of future land-use change (urbanization, land abandonment). Third, consequences of land-use change on energy potentials are evaluated for four regional economies. Results show that (1) conflicts between stakeholders are important spatially explicit regulating drivers for the placement of renewable energy infrastructure on the landscape; (2) for solar energy, the gain of built-up area whose roofs and facades carry solar panels are a major driver of future energy potential, whereas the expected technological advancement does not play a significant role. Contrarily, the social handling with conflicts combined with technological advancement are the main drivers of wind-energy potential ; (3)finally, we show that regional economic impacts of renewable energies are expected to be moderate and will not change regional economies fundamentally for solar and wind.

Does habitat fragmentation indeed decrease biodiversity?

Yaron Ziv, Ben-Gurion University

Landscape ecologists consider habitat fragmentation as one of the major threats to biodiversity conservation. However, a distinction should be made between habitat loss and the two fragmentation per-se (FPS) effects â€“ decreased average patch size and increase average isolation between patches. Habitat loss exists anytime an area is damaged by human activity while the other effects take place only when habitat fragmentation occurs. Consequently, to understand the influence of fragmentation on biodiversity, one should consider only the two FPS effects after cleaning the effect of habitat loss. Using up to four methods to decouple habitat loss from FPS in a heterogeneous landscape, we show that FPS does not affect (beetles), or increases (spiders), species diversity. Additionally, our theoretical (simulation model) and experimental (coral reef fish) studies show that increased isolation may elevate species diversity. These studies demonstrate that various processes, such as competitive release and low predation pressure, mediated by isolation intensity, may enhance between-patch variation and consequently contribute to higher diversity. I argue that contemporary spatial-oriented ecological theories and hypotheses support the idea that FPS has positive effects on species diversity at low and moderate levels of fragmentation. I propose a new hypothesis that combines our current knowledge.

Crossing borders between plant communities: patterns of vegetation across edges in natural heterogeneous landscapes

Karen A. Harper, Saint Mary's University

Transitions between adjacent plant communities are important features of landscapes that might harbour greater diversity or unique structural features. Natural forest edges are less studied than those created by human activity but are more complex. I use an approach in my research which combines a focus on vegetation across natural forest edges with a more extensive exploration of vegetation patterns across the landscape. In my presentation, I will focus on two questions. 1) Are transitions between plant communities more abrupt compared to 'interior' ecosystems? 2) Is the diversity of plant functional groups higher at forest edges? I combined results from studies on forested edges of burned areas, coastal and interior barrens, spruce budworm outbreaks and bogs in Nova Scotia (Canada); forest-tundra ecotone in Churchill (Canada) and grassland-forest transitions in Brazil. Data on different plant functional groups (trees, shrubs, herbs, graminoids, lichens, moss) were collected in 1 x 1 m contiguous quadrats along 120-1350 m transects and analyzed with wavelets. Throughout various landscapes,

abrupt transitions for plant functional groups sometimes, but not always, conincided, and did not always occur at the forest edge. This suggests that boundaries, when defined as the regions of the greatest change, differ for different types of vegetation. Likewise there were often regions of high diversity, but they did not always occur right at the forest edge. In heterogeneous landscapes, patterns of change across transitions between plant communities vary for different plant groups and types of plant diversity.

Question & Answer

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Introduction to Symposium

Patrick James, Universite de Montreal*

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Response of tachinid parasitoids to landscape alteration

Diego J. Inclan, â˜™Pierfilippo Cerretti,â˜™Lorenzo Marini, DAFNAE, University of Padova, Italy*

Although many empirical and theoretical studies have elucidated the effect of landscape intensification on insect herbivores, little attention has been paid to the impacts of this driver on the third trophic level. We investigated the role of landscape processes in shaping the diversity of tachinid parasitoids in both semi-natural and agricultural managed habitats. Within semi-natural habitats, we found that the processes of habitat area reduction and loss of connectivity significantly interacted indicating that management practices to mitigate the negative effect of habitat loss need to consider the surrounding landscape. In particular, parasitoids were more negatively affected by habitat loss in landscapes with low rather than with large habitat connectivity. Within agricultural managed habitats, we found that the positive effect of organic farming on parasitoid diversity can be observed across multiple scales. We found higher diversity on organic than on conventional farms and in landscapes with high proportions of land under organic farming. To restore parasitoid diversity, the promotion of organic agriculture should aim to increase both the total extent of organic farming and the connectivity of individual farms. In conclusion, any management intervention aimed at enhancing tachinid diversity at the local spatial scale needs to take the landscape structure into account. Our research is a first step to understand the spatial dynamics of a key functional group of generalist parasitoids that contribute to control insect pests in both semi-natural and managed habitats.

The Green Landscapes concept: A spatial decision support tool to optimise land-use portfolios for ecosystem service provision in a changing climate.

Thomas Seifert, Department of Forest and Wood Science, Stellenbosch University, South Africa; Stefan Seifert, Scientes Mondium, UG, Germany; Cori Ham, Department of Forest and Wood Science Stellenbosch University, South Africa Shailini Oogathoo, Departmen

Green Landscapes is an initiative to address the need of decision support in regional planning in Africa. Issues of competing land-use, food security, water shortage, C-sequestration and the imminent threat of changing climate pose a big challenge for land-use planning, mainly because of the inherent complexity. A spatial decision support system (sDSS) was designed to address these needs. Extending the scope from sustainable planning of forests to the landscape level, the sDSS that is currently being developed

addresses all major land-use forms in order to compare the ecosystem services that they provide. The sDSS integrates a data base with models for the prediction of ecosystem services. Key is a hydrological model that addresses the major limiting factor in many African countries. The other models that are currently integrated predict ecosystem services such as timber and food production, biomass provision, carbon sequestration, job creation and conservation status for different land-uses. The framework is built completely from public domain components to avoid costly software licenses. This presentation will sketch the concept of the sDSS and report current development efforts to integrate the models for ecosystem service provision in order to optimize landscapes for ecosystem service provision.

Multi-scaled controls on wildfire regimes: the search for better simulation models

Nicholas A. Povak, USFS PSW Research, Hilo, HI; Paul F. Hessburg, USFS PNW Research, Wenatchee, WA*

Cellular automata (CA) are used to simulate complex system behavior to better understand driving mechanisms in the natural systems they are meant to represent. Most CAs use simple mathematical rule sets to represent dynamic physical, social, or ecological processes operating over a flat cellular lattice. CA simulations often result in complex emergent patterns. The Forest Fire model is a CA that simulates fire size distributions (FSDs) in a model forest. Results from this model indicate that purely endogenous controls (random ignitions, ignition frequency, and prior fire patterns) drive characteristic power-law distributed event sizes. However, ecological theory asserts that FSDs in natural systems are more likely driven by hierarchically-organized, multi-scaled processes, drawing into question this explanation. To test this, we fit power-law models to FSDs of 16 California ecoregions. Instead of scale-free power laws, we found evidence of scaling regions, and power-law models only fit a meso-scale range of fire sizes (~100-10,000 ha), suggesting that spatial controls may vary by fire size. We also found that topography (i.e., valley bottoms, aspect breaks) provided relatively strong spatial control on meso-scale fires for most ecoregions. Furthermore, we found that very large fires burning under extreme weather conditions burned most ecoregion area, demonstrating that exogenous controls are primary. A new generation of multi-scaled CA or agent-based models will be required to simulate spatio-temporal controls on natural wildfire systems, to test thresholds in the dominant controls, climate influences on controls, and cross-scale interactions among controls.

How to ensure participation - the nexus between landscape, social and urban planning in sustainable development

*Christine Furst *, University of Bonn, Center for Development Reserarch (ZEF)*

The development of urban-rural or even metropolitan areas is greatly confronted to various and often conflicting societal, but also individual needs. Acknowledging the value of ecological processes in the communication and planning participation particularly of actors from pure urban contexts is a highly challenging and not yet well solved problem. Concepts such as landscape laboratories connected to participatory planning mechanisms might help to bring rural and urban actors, being providers and consumers of essential ecosystem services, easier together. With the software suite GISCAME, including environmental education offers, we started exploring what kind of information, in which information depth, and what kind of answers, are helpful to solve problems in rural-urban planning contexts. We present some approaches how participation can be enabled at different knowledge and training levels and how alternative elements for participation can be integrated. We conclude on how environmental education or training of actors can be included to ensure cross-generation sustainability in regional development and planning in rural-urban contexts.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Patterns of sediment accumulation and characteristics across a Coastal Plain floodplain: The importance of hydrogeomorphic influences and cross-floodplain connectivity

Christopher T. Kaase, University of South Carolina; John A. Kupfer, University of South Carolina*

Sediment generated by poor land use practices in the early 20th century and transferred into regional river systems continues to work its way through Southeastern watersheds, representing a major geomorphic and ecological agent in the regularly flooded bottomlands of the Coastal Plain. Although periodic inundation in floodplain systems is often associated with increased nutrient availability, productivity, and decomposition, stress resulting from high sedimentation rates can outweigh benefits or impact species with specific physiological adaptations. However, considerable uncertainty surrounds sediment dynamics on many large river floodplains. Of particular importance is documenting the factors that affect the flux of sediment from rivers onto their floodplains and its subsequent deposition. In this research, we quantified short-term rates of sediment deposition from 2012-2014 at floodplain sites at Congaree National Park using feldspar pads. Sediment deposition rates ranged from 0.1-15.6 cm (mean = 2.1 cm) and were closely associated with habitat type (flats vs. sloughs), soil texture, inundation discharge (sites marked by high magnitude/low frequency flooding vs. those with high frequency/low magnitude flooding), and geomorphic position. Cross-floodplain distributary channels served as particularly important conduits for moving sediment onto the floodplain. Physical and chemical analyses of soil samples demonstrated that the most flood-exposed sites had higher micro- and macro-nutrient levels (especially of phosphorus), more diverse nutrient compositions, and flood tolerant vegetation types. This research advances current understandings of lateral floodplain connectivity by demonstrating the complex effects of regional hydrology and local floodplain environmental characteristics on the supply of sediment and nutrients.

Sustaining multiple ecosystem services and biodiversity: lessons from landscape ecology

Monica G. Turner, University of Wisconsin; Rose A. Graves, University of Wisconsin; Jiangxiao Qiu, University of Wisconsin; Carly Ziter, University of Wisconsin*

Conserving biodiversity while sustaining multiple ecosystem services (benefits people obtain from ecosystems) has become a priority for landscape management worldwide. However, there is little consensus about the ways and scales at which biodiversity and different ecosystem services are linked and how landscape patterns influence these links. This presentation summarizes lessons from landscape ecology that aid this integration. Some ecosystem services (e.g., pollination, pest control, wildlife viewing, disease regulation) depend directly on biodiversity, whereas others (e.g., crop yield, timber production) are often associated with locally reduced biodiversity. No single landscape pattern can enhance all management goals simultaneously, but the kind, amount, distribution, and configuration of land cover are critical for evaluating synergies and tradeoffs between ecosystem services and biodiversity and managing for their sustainability. Using illustrative case studies from terrestrial and aquatic systems, insights are drawn regarding effects of spatial heterogeneity, scale, landscape context, and landscape connectivity. We demonstrate how approaches from landscape ecology can be used to identify: (1) keystone landscape elements that have disproportionate influence on biodiversity and ecosystem services; (2) spatial thresholds of connectivity that may lead to abrupt changes in biodiversity and ecosystem services; (3) synergies that promote biodiversity and ecosystem services on the same parcels of land; and (4) tradeoffs that will require spatial complementarity of alternative land uses and management over large areas to conserve biodiversity while sustaining multiple ecosystem services.

Community-based planning for conservation and recreation in the James River watershed

Todd Lookingbill, University of Richmond Taylor Holden, University of Richmond Kimberley Klinker, University of Richmond Jeffrey Allenby, Chesapeake Conservancy*

The Envision the James (ETJ) initiative is a community-based effort to prioritize actions for protecting and restoring the cultural and natural resource assets of the James River watershed in Virginia, USA. As part of an initial scoping process, more than 30 non-profit, government, academic, and business organizations identified four core themes for the initiative, each with specific needs and opportunities. We describe two sets of mapping and spatial analysis activities conducted to meet the data demands of the ETJ community. In support of the Heritage and Recreation theme, we developed a new online map of river access points to encourage a broader, more diverse user-group to visit the river. The online tool was created using a linked courses approach. It uses state-of-the-art visualization methods to address issues of environmental justice in the watershed. The second set of analyses applies remote sensing and hydrologic flowpath analysis to support the Landscape Conservation theme. One of the gaps identified in the scoping process was the lack of consistent methodology and data for prioritizing locations for riparian buffer protection and restoration. Using National Agriculture Imagery Program (NAIP) imagery, we conducted high-resolution land cover classifications for the watershed. Concentrated flow path mapping of the new land cover data identify potential hotspots for pollutant discharge into the James River and its tributaries. These data were also used to generate landscape metrics for monitoring the condition and trend of wetland resources in the watershed, another need identified by the ETJ community. The project highlights the role of a common visioning document in bringing together diverse stakeholders for landscape conservation.

A collaborative science platform for seamless land use and land cover: Global Land Use Emergent (GLUE) project

**David M Theobald, Conservation Science Partners; Dylan Harrison-Atlas, Graduate Degree Program, Colorado State University; Nicole Shaw, Conservation Science Partners; Luke Zachmann, Conservation Science Partners; Theresa Nogiere, Conservation Science Par*

Central to understanding current patterns of biodiversity, validating models of threats and effects, monitoring habitat change, leveraging past and future data collection efforts, and collaborating across agencies, ownership, and political boundaries is some representation of land use and land cover. We have worked with a variety of conservation partners to construct a platform to collect and share data on detailed land use and land cover, generated through interpretation of high-resolution areal photography. This provides an efficient means to collect data at a fine resolution, for current and historical landscapes, and to leverage expert and local knowledge. We find these "glue" data especially important because they: (a) provide a means to link detailed understanding of land use drivers to the vast collections of remotely-sensed imagery and other landscape data; and (b) connect with interested agencies, groups, and even individuals (citizen science). We will demonstrate how we leverage the Google Earth platform to provide a means to visualize and input data in careful, coordinate, and consistent way. A flexible, comprehensive, multi-scale random-based design provides a probability-based sampling framework necessary for rigorous design-based estimates, while additional opportunistic points are also supported for modeling purposes. We will describe two transboundary examples of the application of GLUE data to generate a: (1) US-Mexico land cover and land use dataset for the Madrean archipelago ecoregion and (2) a flexible, freshwater sampling design for the US and Canada.

Landscape indicators for the assessment of ecosystem services along a land use intensity gradient

Werner Rolf, Technical University of Munich; Roman Lenz, Nurtingen-Geislingen University; David Peters, University of Tasmania*

A map of ecosystem distribution is an essential reference for assessing ecosystem services. We will present test runs of a quantitative analysis approach based on a gradient data model to develop a map that reflects the distribution of ecosystems. In the first phase we use a pure biogeographical approach. We select biologically relevant environmental variables and calibrate these under incorporation of species information. Explicitly addressing the biotic nature of the ecosystem concept due to the identification of species assemblages and their abiotic environments we consider this as effectively looking for ecosystems. In the next step we suggest that in addition to biophysical data the use of cultural data helps to improve the models capacity to identify patterns and processes between ecological and cultural systems. In this case we are calibrating environmental variables according to land use intensity.Essentially this will lead to an ecosystem-orientated planning framework for cultural landscapes useful for Ecosystem Service assessments. In order to make the analysis process transparent, we used standardised methods with repeatable procedures.The presentation describes the conceptual thrust of the methodology and exemplaryly demonstrates some outcomes of its application within middle European cultural landscapes in Germany.

Remote sensing of Essential Biodiversity Variables in South African biomes

Moses A. Cho, Renaud Mathieu, Abel Ramoelo; Natural Resources and Environment, Council for Scientific and Industrial Research (CSIR)

Changes in climate and land use are having significant impacts on the health and productivity of various ecosystems in Africa including natural and agro-ecological systems. These changes are impacting food security and traditional livelihoods on the African continent at various spatial scales. Essential Biodiversity Variables (EBVs) such leaf nutrient content, vegetation cover, leaf area index (LAI), biomass and vegetation composition are generally considered as important monitoring indicators of the spatio-temporal variability of ecosystem health. Despite the significant progress in quantifying these EBVs through the use of coarse resolution spaceborne sensors such as Moderate Resolution Imaging Spectroradiometer (MODIS), it is generally agreed that the spatio-temporal variability of EBVs on the African continent are not accurately represented or captured by these coarse resolution sensors. Improved spectral, temporal and spectral resolutions are needed to adequately characterise landscape processes resulting from changing climate and land use such as bush encroachment, alien species invasion, changing farming systems and species composition. We have therefore adopted a multi-scale characterisation of EBVs in South Africa using a multitude of sensors from high resolution LiDAR and hyperspectral sensors to coarse scale RADAR and multispectral sensors to map and understand the spatio-temporal variability of EBVs on the South African landscape.

A District-level Approach to Climate and Land Use Change Adaptation Strategies in Forest Landscape Management

Tommaso Sitzia, Thomas Campagnaro, Michele Cattani -University of Padova - Department Land, Environment, Agriculture and Forestry

Jointly with stakeholders we developed a district forest plan in a 41,013 ha Northern Italy valley of the Dolomites (46Â°31' N, 12Â°09' E) as a pilot for developing and integrating measures of adaptation to climate and land-use change in operational forest planning. The main elements of the plan were: i) use and further development of the territorial, environmental, and forest regional geodatabase; ii) zoning of forest areas through multi-criteria analysis according to an hierarchy of ecosystem service and

landscape-level forest types; iii) involvement of key stakeholders through several participatory events; iv) respect the prerogatives given at the local forest planning level. The results showed that the effects of climate change have interacted with the effects of past forest landscape management (e.g., distribution and frequency of silvicultural interventions) and the changes in land use. For example, beech (Fagus sylvatica L.) has shown a remarkable increase in both volume and cover. Therefore, suggested adaptation measures take into account these masking factors on changes driven by climate variations, as well as the uncertainty of the broad-scale climate change scenarios and the effects on the regulation and protective capacity of forests.

Panel Discussion / Session B: Planning innovations through modelling, geodesign and visualization technologies

Christian Albert, Leibniz Universitat Hannover & Helmholtz Centre for Environmental Research - UFZ; Vivek Shandas, Portland State University; Wei-Ning Xiang, University of North Carolina at Charlotte & East China Normal University*

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A Multi-Scale Land Use Modelling approach for the Brazilian Amazon to capture spatial processes of land use change at different scales

Florian Gollnow, Humboldt-Universitat zu Berlin; Tobia Lakes, Humboldt-Universitat zu Berlin; Jan Gopel, Center for Environmental Systems Research; Rudiger Schaldach, Center for Environmental Systems Research*

Most often land use models are limited to a certain spatial scale, ranging from broad scale global models to landscape scale models. While the first possibly capture teleconnections and processes of indirect land use change, they miss the spatial resolution to assess effects on ecosystem services. We propose to link regional land use models with landscape scale models in a nested approach.
Our case study is situated in the Brazilian Amazon along the BR-163, between Mato Grosso and Para state. This has been one of the hotspots of deforestation, linked to distant demand of soybeans triggering the expansion of soy production, increases in cattle productions, and influenced by different policies. LandShift was used to model regional scale trend scenarios for Mato Grosso and Para state considering the timespan from 1970 to 2010 for scenario development until 2050. Crop production area increases by 70%, pasture by 110% and urban areas by 10%. Changes of land use for the case study differ from the regional changes. Crop area increases by 30%, pasture by 106% and urban area doubles. The coupling of models allows the regionalization of the land use demand from the large scale model for the fine scale land use model. This approach accounts for the spatial heterogeneity of the region, affecting for example displacement of land use to regions of higher suitability. Exemplarily, since most of the fine scale study area along the BR-163 is more suitable for pastoral use, croplands do not similarly expand as in the regional model.

The role of geographical context in the distribution of urban tree canopy cover: implications for environmental justice and urban sustainability planning

Kirsten Schwarz, Northern Kentucky University; Adam Berland, USEPA; Dustin L. Herrmann, USEPA; Matthew E. Hopton, USEPA*

As urban landscapes change, so can the spatial distribution of trees - which can provide ecosystem services. A central goal of urban sustainability planning is the equitable distribution of ecosystem services among peoples of differing socioeconomic groups. Therefore, ecologists and urban planners

have sought to understand how tree canopy is distributed relative to race, income, and education. We investigated the role terrain may play in modifying the spatial distribution of tree canopy in Cincinnati, OH. Terrain accounted for 59% of the variation in tree canopy cover, while socioeconomic variables describing race, wealth, and education did not explain significant variation in canopy cover. Tree canopy was abundant in two hilly areas with dissimilar socioeconomic characteristics - the western hills, where median home values are lower and a higher percentage of the population identifies as black, and the eastern hills, where median home values are higher and a larger percentage of the population identifies as white. Our results find the overwhelming importance of local biogeophysical context, specifically terrain, obscures patterns between tree canopy and socioeconomic variables. Identifying the drivers of socio-ecological patterns in urban landscapes can help us understand how future landscape change may support or impede urban sustainability goals.

Dynamics of soil erosion under varied landuse/cover in Rwizi catchment, Lake Victoria Basin: Implications on landscape and livelihood resilience

Yazidhi Bamutaze, Makerere university; Hosea Opedes, Makerere University; Bernd Diekrugger, University of Bonn

Soil erosion remains a fundamental development challenge in tropical African landscapes with implications on landscape and livelihood resilience. However, the magnitude and variability of soil erosion under predominant land uses and land covers is not fully resolved. In this study, we assessed the magnitude and variability of runoff and soil loss from Rwizi catchment in the Lake Victoria Basin. 36 runoff plots covering four landuses/covers (mulched banana, unmulched bananas, tree plantation and grassland), three slope positions (lower, middle and upper) and three replications were used for measuring runoff and soil loss. The runoff plots meased 20X2 meters and were installed on farmers fields. Rainfall depth was also measured using a rain gauge. Total annual rainfall measured was 889mm which is within the expected amount for the area. Runoff was in the order of tree plantation>unmulched banana> grassland=mulched banana. The lowest and highest annual runoff registered from land uses/covers was 140 and 159cm3/ha/yr. In terms of soil loss, it was in the order of unmulched> tree plantation> grassland> mulched banana. Average annual soil loss under land use varied from 0.59t/ha/yr to 1.54t/ha/yr. The registered magnitude of annual soil losses are within the tolerable limits for tropical soils and reflects elements of good farmers stewardship for livelihood sustainance and landscape resilience.

Indicating intervention options: spatial identification of ecosystem services from wetlands in Uganda.

Charlie Langan, University of Aberdeen & Carbon Foundation of East Africa*

The Ecosystem Services (ES) research field often focuses at the landscape scale or greater, covering different ecosystems and management jurisdictions. Principally the ES approach is a framework for environmental management, and therefore is most valuable for understanding the supply of ES at the same scale as land management decisions occur. Wetlands in Uganda are common goods, and are managed in a diversity of ways by local actors, including wetland farmers and conservation groups. There are significant trade-offs between food production and climate regulation, as well as other important services such as water and fibre availability as a result of land management practices. For an ES approach to be useful in optimising decision-making for sustainable wetland management, assessment of the types and quantities of ES supplied is required that is sensitive to both land management practices and spatial location within a wetland system at a field plot scale. An indicator methodology for the spatial identification of ES supply within wetlands is presented, which uses a Bayesian Belief Network (BBN) within the ES cascade framework. The BBN model is populated by

empirically derived relationships from fieldwork and the academic literature, and requires geospatial data to determine the ES supply across a wetland system. The BBN is validated by a spatial survey within two wetland systems in the South West of Uganda. The model develops an understanding of trade-offs between land management configurations, explores the impact of future land use scenarios on ES supply and provides guidance for the location of sustainable wetland management interventions.

Urban Areas as Landscape Elements: Standardizing Terms and Methods

Ian MacGregor-Fors, Laboratorio de Ecologia en Ambientes Perturbados, Red de Ambiente y Sustentabilidad, Instituto de Ecologia, A.C.; Martha Bonilla-Moheno, Red de Ambiente y Sustentabilidad, Instituto de Ecologia, A.C.; Carlos Munoz-Robles, Instituto de*

Urban areas have important socioeconomic and ecological implications; however, there is no consensus on the concept behind the urban term. In order to fill this gap, standardized and repeatable methods, backed with robust quantifiable definitions, are needed. Based on a recent measurable and multivariate definition of the urban concept and the idea that urban areas form ecotones with apposed non-urban systems, we propose an approach to delineate the limits of urban areas, considering them as part of human-modified landscapes. Briefly, the method considers urban structure aggregation and communication as basic criteria to delineate the borders of any urban area. After assessing the applicability of the method in five large urban areas located in different parts of the globe (i.e., Los Angeles, US; Mexico City, Mexico; Bangalore, India; Barcelona, Spain; Sorocaba, Brazil) and testing its repeatability through a volunteer exercise, it showed to be robust, applicable, and repeatable. Having a consistent and comparable method to delineate the limits of urban areas worldwide could provide advantages for urban ecologists, landscape ecologists and managers, and policy makers. Based on the proposed method, we suggest the use of a new concept (urban entity) for referring to urban areas that maintain aggregation and connectivity in a determined period of time.

Avoiding coastal regime shifts in the northern Great Lakes

Jodi S. Brandt, Dartmouth College

Invasive species are a leading component of environmental change and can lead to dramatic ecosystem shifts. In the North American Great Lakes, coastal wetlands are â€œkeystone structuresâ€ for regional biodiversity and ecosystem services. Recent climate-induced water level changes have led to the establishment of new patches of highly invasive wetland plants, which if left unchecked, will spread rapidly, leading to coastal zone regime shifts. Early detection and eradication (EDE) is the most effective means of invasive species control, but implementing EDE is challenging in complex social-ecological landscapes. In this talk, I present my work with the Sault Tribe of Chippewa Indians, an Anishinaabek community on Lake Superior, whose tribal homelands contain many of the last remaining high-quality Great Lakes wetlands. Specifically, our project a) develops novel satellite image analysis techniques to identify new invasions, and b) integrates the computational work into an ongoing tribally-led â€œEarth Stewardshipâ€ project. Landscapes worldwide are experiencing shifts in underlying drivers of ecosystem change. The objective of our project is to identify the technical, social, and institutional structures necessary to pro-actively steer changing ecosystems on sustainable trajectories.

Function Modeling: a fast and efficient spatial modeling framework

John Hogland, USDA/RMRS; Nathaniel Anderson, USDA/RMRS*

Raster modeling is an integral component of spatial analysis, remote sensing, and landscape ecology. It has been used to address a broad array of questions ranging from resource decision making to scientific

hypothesis testing. However, with conventional raster processing techniques, there are some considerable limits to answering fine grained questions at regional extents. Advances in computing technology have helped to alleviate some computational limitations, but we continually find ourselves reaching thresholds of what is practical and possible when it comes to processing and storage. Even when research designs are generally appropriate for a given hardware configuration, the techniques available to perform raster type analyses and the coding paradigm used for processing can have a significant impact on the feasibility of data intensive analyses that push the boundaries of GIS. This presentation explores new coding techniques for raster and spatial modeling and promotes a fundamental shift in the processing paradigm to one that facilitates faster, more efficient modeling. The new technique, called Function Modeling, leverages concepts of delayed reading, function raster datasets, and object oriented programming to minimize the number IO procedures used within the conventional spatial modeling framework. To facilitate and illustrate the use of Function Modeling, we have built a .NET coding library that performs a wide variety of spatial, statistical, and machine learning type analyses within a delayed reading architecture. Using these libraries and concepts transforms analyses that were once impractical to perform into realistic workflows that solve formerly intractable spatial problems.

Global climate change

Philip Mote, Oregon Climate Change Research Institute*

The Fifth Assessment Report of the Intergovernmental Panel on Climate Change summarized thousands of papers concerning the physical and biological causes and effects of a changing climate. This talk will summarize the state of science as it pertains to coastal ecosystems.

Mapping and quantifying cultural ecosystem services at regional and continental scales using spatial scraping of web content

Derek van Berkel, Brian Pickard, Ross Meentemeyer. Center for Geospatial Analytics, North Carolina State University*

Over the past decade much effort has been placed on mapping and quantification of ecosystem services for articulating the societal benefits derived from ecosystem processes. Particularly hard fought in this work has been conveying the significance of cultural ecosystem services (CES). Several new and promising methods that measure perceptions and values of landscapes have been developed, yet challenges remain for effectively mapping and quantifying CES. Often studies have been constrained to local scale assessments that are unrepeatable due to the time and cost of collecting landscape perceptions of people. This has been prohibitive for understanding the spatial variation and dynamics of CES. Web content offers a potentially valuable repository of indicators for evaluation of CES that overcome these spatial and temporal limitations. Global emergence of micro blogging, reviews and photos volunteered via geo-location tracking systems utilized in mobile devices has enabled monitoring of activities and opinions for specific locations. We present a method for mapping and quantification of CES that leverages this web content using a technique called spatial scraping. Spatial scraping automates the collection of georeferenced information from the World Wide Web. We scrape tweets, flickr photos and tourist locations for localizing recreational activities, and opinions about the aesthetic beauty and inspiration invoked by landscapes. Through spatial analysis of these indicators and a time/cost estimate of the value of CES, we are able to map and give a lower bound dollar estimate of the benefits derived from the landscapes of the US and North Carolina.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Contextualizing Red-List Species Conservation in Urban Areas: Species Richness and Landscape Preference in Singapore, Tokyo and Vancouver

Khew Yu Ting Joanne, The University of Tokyo*

To harness maximal regulatory, provisional and cultural ecosystem benefits from urban green-spaces, the conservation success of red-list species can be used as an indicator for the creation of ecologically viable and contextualized native landscapes. However, current urban-based red-list conservation measures largely originate from developed-countries in the global-North and are broadly applied to cities around the world despite their unique socio-ecological profiles. Though well-meaning, this creates uniform urban landscapes which vary in social and ecological effectiveness by location. This study aims to contextualize green-space creation and red-list species conservation in three cities within different ecological zones: Singapore, Tokyo (23 Wards) and Vancouver through (1) quantifying landscape preference of urban-dwellers and its underlying preference drivers, (2) profiling red-list species richness change across habitats with varying degrees of human interference and subsequently, (3) providing recommendations for conservation with concurrent consideration of habitat-type irreplaceability for each study site. Findings reveal a decreasing species-richness gap between naturalistic landscapes (primary/ old-secondary vegetation) and urban manicured landscapes in Singapore, followed by Tokyo, then Vancouver. A similar trend was found for habitat-type irreplaceability of manicured landscapes across the study-sites. However, results of landscape preference conversely reflect the aforementioned trends; and manicured landscapes were increasingly preferred over naturalistic landscapes in the order of Singapore-Tokyo-Vancouver due to the decreasing visually discernible difference in diversity (conservation capacity) and complexity between the two landscape types. Results therefore elucidate city-specific social and ecological uniqueness. This highlights the need for application of contextualized microclimatic modifications to increase the conservation capacity within non-complex manicured landscapes.

How to optimize urban eco-spaces for health city based on ecosystem service assessment?

Liding CHEN, Ranhao SUN, Zhifeng WU, Lei YAO Research Center For Eco-Environmental Sciences, Chinese Academy of Sciences*

Increasing population and rapid urbanization in the urban area may lead to loss of green spaces and ecosystem services at generating traffic congestion. However, cities are believed to be the best space-efficient solution to meeting the economic, environmental and social needs of human society at less cost of natural capital and biodiversity. With the rise of global human population residing in urban areas, the provision of ecosystem services to urban residents is becoming an important issue, particularly at the increasing demand for improving human life. How to build a healthy city is becoming an important issue faced by human. In such situation, green landscape in the urban areas becomes the focus and is believed to be a vital resource for meeting human needs in urban areas. However, how to make an optimized eco-space in the urban areas is still in dispute. In this paper, a framework was proposed on how to make an optimized urban eco-space for improving urban health. The eco-space here, is specifically defined as a three-dimension space that is measured based on ecosystem services offered by green landscape in the urban areas. The framework comprises three levels: urban landscape planning at city level, landscape pattern design at lot level and vertical greening at building level. In each level, the ecosystem services are calculated based on the primary driving factors and trade-offs between the demand from local citizens and the provision of ecosystem service from green landscape are made.

Land-use impacts on the terrestrial carbon cycle: an integrative tool for resource assessment and management

**Benjamin M. Sleeter, U.S. Geological Survey, Western Geographic Science Center; Tacoma WA, USA; Jinxun Liu, San Jose State University Research Foundation; Menlo Park CA, USA; Colin Daniel, Department of Ecology & Evolutionary Biology, University of Toron*

Land use (e.g. cultivation, timber harvest, urban development) and natural processes (e.g. climate, wildfire, and disease) affect the ability of ecosystems to store and sequester carbon, potentially offsetting greenhouse gas emissions. Landowners, managers, and policy makers require data, information, and tools on the relative influence of these various drivers on ecosystem carbon stocks and fluxes in order to evaluate alternative policies and management strategies designed to increase carbon storage and sequestration. We present a modeling framework for simulating changes in ecosystem carbon resulting from anthropogenic land use and management decisions, wildfire occurrence, natural vegetation change, and climate variability, under a range of future conditions coherent with IPCC global change scenarios. Land-use and vegetation change is simulated using a state and transition simulation model while an integrated stock and flow module is used to track carbon living biomass, litter, soil, deadwood, and wood products. We have implemented the model across a range of ecological regions in the western U.S. Here we discuss the overall model structure and parameterization, the sensitivity and uncertainties related to individual drivers of carbon change, and the resulting projections across a wide range of future scenarios.

Moderated Discussion

Moderators: Ji Han, Wei-Ning Xiang, Marina Alberti, Kenichi Nakagami

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Use of remote sensing based landscape matrix for understanding grazing patterns in the protected areas of the African savanna

Abel Ramoelo, Moses Cho, Renaud Mathieu Earth Observation Research Group, Natural Resource and Environment, Council for Scientific and Industrial Research (CSIR), Pretoria, 0001*

Understanding the grazing patterns of herbivores in the protected areas is critical for biodiversity conservation. Biodiversity is threatened by the sporadic increase in land cover or use and climate change. Understanding the grazing patterns provides information on population dynamics as results of changing ecosystems. Conventional and point based techniques have proved to be costly and laborious to assess the determinants of the grazing activities. The remote sensing based landscape matrix including the distribution of grass quality (e.g. Leaf nitrogen concentrations) is critical for assessing grazing resources. Grass quality influences the grazing patterns and movements of herbivores. The importance of this landscape matrix is not usually explored because of the unavailability of the high spatial resolution data. The study will demonstrate the use of remote sensing products such as grass quality derived from RapidEye sensor for understanding herbivore grazing patterns. The basic statistical analyses were used to compare animal densities and nutrient availability. The species census data was acquired from the Sabi Sands private game reserve, north eastern part of South Africa. The species specific density data were created, e.g. for impala, bushbuck, elephant, wildebeest, buffalo and duiker. The correlation between species specific densities and leaf nitrogen or grass quality varied significantly, indicating that some species are influenced by the grass quality than the others. Species such as elephant are driven not only by quality but also by quantity (biomass). Further, analysis should include variety of landscape matrix such as fibre, lignin, biomass and phosphorus as both the attractants and deterrents of herbivores. Remote sensing based landscape matrices could play a crucial role in

understanding the dynamics of animal grazing, for planning and management of the grazing systems and biodiversity.

Designed responses to urban vacancy: Aligning environmental and social processes in Detroit

Joan Nassauer, University of Michigan, USA;Natalie Sampson, University of Michigan-Dearborn, USA; Alicia Alvarez, University of Michigan; Allen Burton, University of Michigan; Margaret Dewar, University of Michigan; Shawn McElmurry, Wayne State Universit*

While vacancy in cities is driven by social, economic, and governance factors, vacancy is most apparent as a landscape phenomenon. The stunning appearance of vacant urban landscapes can prompt recognition of the need to design landscape change. Furthermore, the low-demand land markets that characterize vacancy allow for low rent landscape-based solutions. However, landscape-based solutions may not be adequately informed by knowledge of environmental and social processes. This paper will describe in detail a transdisciplinary research project that has been carefully calibrated to use knowledge bases from design, planning, law, and social and natural science disciplines to address pressing environmental and social problems in Detroit, MI, USA. Responsive institutional research support for innovation has promoted collaboration among scientists in diverse disciplines together with local government decisionmakers to develop and test novel designs for the demolition of abandoned structures and repurposing of vacant property, and to analyze the capacity of governance to support the social and environmental function of these designs. These designs are intended to allow vacant property to improve water quality, reduce neighborhood flooding, and improve the health and well-being of neighborhood residents. In this paper, we will report early results from social and environmental assessment of the performance of demonstration designs and their supporting governance structures.

Planning and design for novel nature to support urban resilience

Jack Ahern University of Massachusetts Amherst, USA*

If the 21st Century world is to be sustainable and resilient, cities will be an essential part of the solution - and the sustainability and resilience of cities must address the structure, function and appearance of all forms and variants of urban nature. A new conception of "novel" urban nature is proposed here as a key strategy to provide urban ecosystem and landscape services to support urban resilience. The proposed novel nature strategy is informed by landscape ecology and is consistent with urban landscape architecture practice. A typology is proposed for classifying novel landscapes/ecosystems based on biodiversity/species composition and the type and intensity of human intervention/management. Importantly, novel urban nature can be designed and/or managed to support urban resilience strategies (biodiversity, connectivity, multifunctionality, redundancy and modularity, and adaptive design). The monitoring and assessment of performance of novel nature is both a requirement for public acceptance and as a means of experimentation and innovation with new and hybrid types of urban novel nature.

Synthesis

Tom Miewald

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Concluding Remarks

Frederik Doyon, Institut des sciences de la foret temperee, Universite du Quebec en Outaouais

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Competitive advantage of Sphagnum fallax: Implications for vegetation succession in peatland landscapes

Jin-Ze Ma, Zhao-Jun Bu, Xing-Xing Zheng, Jia-Li Ge and Sheng-Zhong Wang -*
Institute for Peat and Mire Research, Northeast Normal University, State Environmental Protection Key Laboratory of Wetland Ecology and Vegetation Restoration, China

Sphagnum, an important genus of bryophytes in peatland landscapes. It faces the threat of shading under current circumstances of environmental change. In Sphagnum, hollow species are competitor due to their high growth rate. Whether current and future shading will weaken the competitive advantage of hollow species is unknown. Three species (two hummock species S. palustre and S. capillifolium and one hollow species S. fallax) were used in a growth chamber experiment by simulating shading and creating Sphagnum communities. Shading had no effect on biomass production or side-shoot production but increased height increment in all three species. It also increased C and N content but decreased C:N ratio in the capitula. Inter-specific neighbors inhibited biomass and side-shoot production in the two hummock species but had no effect on the hollow species. All three species showed interaction between shading and neighbor in two or more plant traits. S. fallax showed competitive advantage over S. palustre in non-shading treatments and over S. capillifolium in moderate shading treatments. In addition, under deep shading, S. fallax showed competitive advantage over both hummock species, and a clear competitive hierarchy S. fallaxï¼žS. capillifoliumï¼žS. palustre emerged which was consistent with the hierarchy of side-shoot production. The results suggest that all the sphagna appear to tolerate deep shade. In a shading environment, especially under deeply shaded conditions, S. fallax still can keep its dominance in hollow habitats by virtue of its advantage in side-shoot production if water availability is guaranteed.

Characterizing interacting effects of streamflow and temperature on the vulnerability of fishes in the Western U.S. to climate change

Dylan Harrison-Atlas, Graduate Degree Program in Ecology, Colorado State University; David Theobald, Conservation Science Partners; LeRoy Poff, Department of Biology and Graduate Degree Program in Ecology, Colorado State University*

The distribution of freshwater species is uniquely tied to natural flow and thermal regimes that describe the dynamic character of stream and river systems. Climate change is expected to alter hydrological and thermal conditions in ways that threaten the persistence of fish species in the western United States. Predicting the effects of climate change on multiple species across broad geographies is a major challenge, yet critical for informing adaptation strategies that are increasingly based on vulnerability assessments that quantify the conditions that determine species risk. Among the difficulties in characterizing vulnerability to freshwater systems are regional variation in climate exposure and sensitivity to change, interactive effects of multiple environmental drivers including other forms of anthropogenic disturbance, and the hierarchical scaling of riverscapes. We applied climate-relevant trait states as a coarse filter to identify species at risk to climate change using data collected for the US Environmental Protection Agency's Environmental Monitoring and Assessment Program Western pilot study and the National Rivers and Streams Assessment. Here we describe our proposed methods for characterizing the sensitivity of these species along temperature gradients that reflect plausible climate futures. To account for potential interacting effects from changes in temperature alongside key environmental drivers, we explore the utility of Boosted Regression Trees for modeling species occurrence. Lastly, we plan to investigate the role of reach and catchment-scale features in explaining

spatial variability in climate impacts to explore which landscape settings may moderate the effects of climate change.

Population dynamics can be more important than climate change for determining future tree species distribution change in a temperate deciduous forest

*Wen J. Wang *, Hong S. He -School of Natural Resources, University of Missouri; Frank R. Thompson III , USDA Forest Service, Northern Research Station, Columbia, Missouri USA; Jacob S. Fraser, School of Natural Resources, University of Missouri*

Predictions of regional tree species distribution in response to climate change often rely on species-specific, niche-based models and plant functional types-based biophysical process models. These models usually simplify or ignore population dynamics (species demography and interaction) and harvest. We determined the relative importance of population dynamics, harvest, and climate change to tree species distribution in a 125-million ha Central Hardwood Forest Region of U.S. We used a forest landscape modeling approach to project changes in presence, density, and basal area of 23 tree species due to population dynamics, harvest, and four climate scenarios from 2000 to 2300. On average, population dynamics, harvest, and climate change explained 91, 7.7, and 0.2% of the variation in species presence at 2050, but their contribution changed to 61, 6, and 31% by 2300. Climate change led to substantial increases in the distribution of red maple and southern species (e.g., yellow poplar) and decreases in northern species (e.g., sugar maple) and most of widely distributed species (e.g., white oak). Harvest interacted with climate change and accelerated change in some species (e.g., increasing southern red oak and decreasing American beech) while ameliorated the changes for others (e.g., increasing red maple and decreasing white ash). We concluded that population dynamics was the primary driver of tree species distribution over the next 300 years. The effects of harvest were more important than climate change in the short term but climate change became more important than harvest in the long term.

Symposium Discussion

Elizabeth Nichols, University of SÃ£o Paulo, Brazil, Swarthmore College, USA Jean Paul Metzger, University of SÃ£o Paulo, Brazil*

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Ecological concepts in design and planning in the Middle East: historical precedents, project initiatives, and challenges

Yaser Abunnasr, Department of Landscape Design and Ecosystem Management, American University of Beirut*

Contemporary applications of ecological concepts in planning and designing landscapes (urban-to-rural) in the Middle East (ME) remain novel. While there is a tradition of viable historical social-ecological systems that demonstrate a dynamic balance between societies and landscapes, applications in contemporary projects remain rare and at odds with this tradition. With fast urban development, water scarcity, ecosystem deterioration, population migration and projected climate change impacts on the region, an ecological approach in planning and design projects is needed to contribute to reversing these trends, safeguarding natural systems and providing a framework for a more ecologically sensitive approach to landscape planning and design. A survey of traditional social-ecological systems in the ME articulates the long standing tradition of sustainable management of landscapes. Examples include the Hima (a commons managed by communities) in the Arabian Gulf Region, olive tree orchards in the

Levant, and cork tree reserves in Morocco. Ecological principles are derived that are relevant to the contemporary ME context. This is followed by a presentation of contemporary design and planning projects and research initiatives that incorporate ecological concepts. Examples are organized by scale and provide an overview of how and to what extent these principles drive projects. Social-ecological precedents and contemporary initiatives provide the impetus to articulate the current state of affairs, policy and structural limitations as well as future challenges. Concluding remarks present an ecological framework for planning and design professionals, specific in the ME to ensure functional landscapes, meaningful places, and a more resilient future.

The Four Faces of the Design-in-Science Paradigm: Will These Four Expert-Driven Perspectives Radically Reshape How Research and Application Inform Key Concepts about the Sustainable City?

Laura R. Musacchio, Department of Landscape Architecture, University of Minnesota*

The design-in-science paradigm has rapidly grown in the United States from its original roots at the interface of ecology and design. This presentation explores four faces or perspectives of the design-in-science paradigm and how they might radically reshape how research and application inform key concepts about the sustainable city. The first part of the presentation reviews the four faces of this important emerging paradigm, which at times complement and conflict with one another. The first face of the design-in-science paradigm emerges from landscape ecology research in such works as Design in science: extending the landscape ecology paradigm by Nassauer and Opdam (2008). The second face of the paradigm comes from restoration ecology and how it is applied to restoration design practice, which includes very polluted and neglected sites in cities. The third face of the paradigm comes from the development of new design credential systems such as Leadership in Environment and Environmental Design (LEED) and Sustainable Sites, which establish particular performance benchmarks for site-based sustainability. The fourth face of the paradigm is concerned with using scenario planning and urban design to rethink the sustainable city as a complex system of resilient infrastructure and ecologies. The second part of the presentation compares how these four faces extend the biophysical sciences-social sciences model of research, which is the foundation of STEM and the American university system, in important new ways-such as the potential of causing shifts in how research and application about the sustainable city are conducted in the United States.

Multiscale relationships between urban impervious surfaces and land surface temperatures in China

Qun Ma, Center for Human-Environment System Sustainability, Beijing Normal University, China; Jianguo Wu, Center for Human-Environment System Sustainability, Beijing Normal University and School of Life Sciences & School of Sustainability, Arizona State U

Quantifying the relationship between urban impervious surfaces (UIS) and land surface temperatures (LST) is crucial for mitigating urban heat island effects and designing sustainable cities. However, the seasonal and diurnal variations, as well as the scale-multiplicity, of this relationship remain poorly understood. In this study we investigated the seasonal and diurnal variations of the UIS-LST relationship in China across three spatial scales: urban core, urban cluster, and ecoregion. Our study showed that there were large seasonal and diurnal variations in the relationship, with higher mean coefficients of determination (R2) in summer than winter and in nighttime than daytime. The UIS-LST relationship differed greatly with scale, with both the mean and variability of R2 increasing from the ecoregion scale to the urban core scale. The spatial heterogeneity of R2 also increased as the spatial scale decreased. In addition, vegetation and climate had significant negative effects on the UIS-LST relationship during the daytime in summer at the ecoregion scale. By contrast, neither vegetation and climatic conditions nor urbanized area had a significant impact on the UIS-LST relationships at the other two scales. Our results

highlight the importance of the multiscale analysis of how urbanization affects climate, and provide new insights into urban heat islands.

Sami land use 1555-1850 in northern Scandinavia - quantitative data on forest use and human impact

Lars Ostlund, Anna-Maria Rautio, Anna-Lena Axelsson, Torbjorn Josefsson*

Quantification of past land-use and particularly in pre-industrial times and among native people's is a challenge. Here we used a novel approach to quantify early native Sami resource use across a large region, covering c. 21 000 km2 in northern Sweden and during a long time-period encompassing 300 years (1555-1850). We focused on the use of a crucial natural resource: Scots pine (Pinus sylvestris), the most common tree species in the region. The approach is based on extrapolation of quantitative data obtained from small-scale case studies on the resource, and using precise historical records documenting the number of people for the same area for the entire time-period. Our analysis shows that Sami uses of Scots pine trees of specific types and diameters and for various purposes in pre-industrial times were far below critical threshold levels for sustainability. In contrast, the early logging dramatically depleted the region of large diameter pine trees in just 40 years in the late 19th century. Based on our results we also present a conceptual model of overall native Sami resource use in the past and how the use of different resources interplayed in their movement patterns over the landscape.

Legacies of slash and burn cultivation - an integrated study of landscape pattern and forest vegetation in Southern Estonia

Pille Tomson, Institute of Agricultural and Environmental Sciences, Estonian University of Life Sciences; Robert G. H. Bunce, Institute of Agricultural and Environmental Sciences, Estonian University of Life Sciences;*

Data on landscape history are essential to understand current landscape patterns and develop conservation policies. The consequences of slash and burn cultivation, which lasted until the Twentieth Century in Estonia, have been neglected, compared with other studies of land use change. The paper describes the scope and characteristics of fire cultivation in the Nineteenth Century and also analyses its impacts on contemporary landscapes and forests. The study sites are located in Karula and Haanja in Southern Estonia. Statistical comparisons of Nineteenth Century and contemporary maps showed that sites used for slash and burn then covered 34% of farmland but, by the late Twentieth Century, 77% had become forest. Fieldwork was then used in precise historic land use patches, identified by old maps, to compare the characteristics of former fire cultivation sites (35) and old forests (31). Data were recorded from random plots on vegetation, soils and landscape elements and were analysed using standard statistical methods. In Karula the old forests were more acidic and less nutrient rich than slash and burn sites. In Haanja the old forests were less acidic and more nutrient rich. Fire cultivation sites in both regions were similar in their environmental characteristics. Vegetation differences were also described. It is therefore is necessary to understand landscape history to interpret the landscape ecology of Southern Estonia.

Ecosystem services from forests across different scales of governance

Sonia Carvalho Ribeiro, Universidade Federal Minas Gerais UFMG; Britaldo Soares Filho, Universidade Federal Minas Gerais UFMG*

Forests provide a range of goods and services that are of utmost importance in addressing the challenge of managing for "sustainable landscapes". However, it is difficult to implement sustainable forestry management (SFM) across landscapes because of interactions between the different scales at which

planning and decision making take place, as well as spatial variations in stakeholder preferences for forest characteristics and the ecosystem services that forests are able to deliver. This work adopts a multi-scale approach to investigate mechanisms for the implementation of SFM particularly addressing the issues embed in the assessment of ecosystem services from forests at different scales of governance. It uses GIS techniques together with quantitative (e.g. statistical analysis) and qualitative approaches (e.g. focus groups meetings), aided by visual tools such as photographs. The assessment of ecosystem services from forests has been made through two different research projects. One project by World Bank (2014) develops in Brazil and other was conducted by CIBIO in the context of Northern Portugal (Carvalho Ribeiro et al 2011). The results indicated that forest characteristics, roles and public preferences varied at several geographical scales. This suggests that strategies for SFM need to vary as well, but also take into account the cross scale linkages. The study provides a template for developing sustainable forestry practices but additional research is needed to extend the "toolkit" used here and address the policy and management challenges that remain.

Using continuous datasets to understand dynamic transformation of native ecosystems over time in the South of Chile

*Karla Locher*Â¹, Sven LautenbachÂ², Martin VolkÂ¹ Â¹Department Computational Landscape Ecology, UFZ Helmholtz Centre for Environmental Research.Â²Institute of Geodesy and Geoinformation, University of Bonn.*

Land use/cover change is one of the most important drivers of global change and has major impact of the ecosystem services supply from the local to the global scale. The understanding of the complex human influence on land cover dynamics is a critical factor to link ecosystem transformation to land and environmental management. Even though land cover information is widely reported, most of the studies using land cover data compare only two or three periods with a clear lack of a finer temporal resolution. These land cover change approaches might hide landscape patterns critical for the understanding of temporal dynamics. To overcome this shortcoming, we present a methodology where we i) map land cover composition and configuration change using time series of Landsat TM/ETM+ images (1985-2011) in Southern Chile, and ii) analyze land cover patterns to understand the continuous transformation process of a temperate rainforest relict and biodiversity hotspot. We use all available Landsat images from 1985 to 2011, supported by random forest machine techniques. According to this dense data, the deforestation process was more intense at the beginning of the study period followed by progressive slowdown overtime, remaining almost constant during the last periods. The results showed an increasing of the forest exotic plantations and low connectivity between native forest patches. A finer temporal resolution allowed us to discover aspects that would otherwise been lost such as the peaks of conversion from native forest to exotic forest plantations. Native ecosystems show a dynamic transformation over time, confirming the pressure of transformation to more intensive land cover. This is a base for an analysis of synergies and trade-offs among land cover and ecosystem services and functions over time.

Impacts of land use pattern on heavy metal concentration in agricultural soils: a multi-scale analysis in Wuxi, China

Ming Zhu, Lijie Pu*

Rapid urbanization in the past 30 years has triggered tremendous land use change and serious environmental problems in China, including heavy metal pollution. Understanding the scale effects of land use pattern on heavy metal contents is essential for monitoring and assessing the environmental consequences of land use change. After several decades of fast industrialization and urbanization, Wuxi,

China has encountered serious heavy metal pollution in cultivated land. To quantify scale effects, we used a high resolution land use map and the heavy metal contents (As, Cd, Cu, Hg, Pb, Zn) of 1938 soil samples in agricultural land, analyzing the connection between land use pattern and soil heavy metal contents around sample points with radii ranging from 50 m to 2500 m. The correlation coefficients of each landscape metric and heavy metal concentration exhibited distinctive behavior with increasing radius, indicating that the key scale effect land use on heavy metal concentrations varies by landscape metric. Correlations between the concentration of Hg and As and land use pattern were more significant than that of Zn, Cu, Pb and Cd, suggesting that non-point pollution might be the major sources of Hg and As pollution in Wuxi. Generally, land use played an important role on heavy metal pollution in the agricultural soil of Wuxi, while scale affected the significance of the impact.

Anthropogenic invasion pressure improves prediction of invasive forest plant distribution in urban landscapes

Amy J. Davis, UNC Charlotte Department of Geography & Earth Sciences; Ross K. Meentemeyer, NCSU Center for Geospatial Analytics; Jean-Claude Thill, UNC Charlotte Department of Geography & Earth Sciences*

Despite the pressing need to manage invasions in order to protect the conservation values of forests embedded within metropolitan landscapes, species distribution models (SDMs) of invasive forest plants in urban landscapes remain largely unexplored. Due to the spatial concentration of human activity in metropolitan areas, we expect that anthropogenic invasion pressure (AIP) is an important driver of invasions, distinct from dispersal from nascent foci. To test this hypothesis, we collected presence/absence data on a widespread forest invader, Ligustrum sinense, from 400 random plots located across 70 forest fragments stratified along an urban to rural gradient to capture the spectrum of heterogeneity that exists across the greater Charlotte, NC, metropolitan area. We developed a base SDM containing only environmental predictors, and then evaluated the contribution of two spatially explicit metrics: 1) landscape scale AIP (based on probability of dispersal from residences) and 2) local scale neighborhood invasion pressure (representing dispersal from nascent foci). Our results indicate that models that account for AIP have substantially higher accuracy than the environment only model, and is a better predictor of privet occurrence than neighborhood invasion pressure. In addition, our results show that high AIP increases the risk of invasion in environmentally suboptimal habitats, providing empirical support that AIP can overcome abiotic resistance to invasion, as has been demonstrated by others for neighborhood invasion pressure in experimental studies. Our approach demonstrates the importance of accounting for AIP in SDMs in order to increase the chance that habitats at risk of invasion are not left unidentified.

Ecosystem services vulnerability assessment within the Appalachian Landscape Conservation Cooperative

Lars Pomara, US Forest Service; Danny Lee, US Forest Service*

Vulnerability assessment is a broad framework used to inform environmental decision-making, by evaluating the dimensions and trajectories of environmental change, the likely impacts of change on systems of interest, system resiliencies or adaptive capacities, and uncertainties in each of these. This is a useful approach for understanding the risk of losing valued ecosystem services, or the potential for gaining them, given particular actions or failures to act, in the context of rapid environmental change. In a spatially explicit context, ecosystem service provisioning may be projected over space and time as an outcome of the distributional dynamics of various ecosystem capacities, stressors, uses, and management interventions. Understanding these processes at large landscape scales has value for more

local resource management decision-making, but only if vulnerability assessments are carried out in the context of effective researcher-practitioner communication. We illustrate the potential for spatially explicit, regional ecosystem service vulnerability assessment to inform natural resource management and conservation planning, using the Appalachian Landscape Conservation Cooperative (LCC) as a case study. We build on existing work to recommend design principles for integrated ecosystem services assessment. We suggest that the greatest challenges are not in developing new analytical approaches, but rather in developing effective communication among conservation actors and thereby designing work that addresses real needs. The LCC network may be one example of a research-practitioner partnership within which such challenges can be addressed.

Documentation of major disagreements when comparing LCT 2000 data to NLCD 2001 land-use and land-cover data

Daniel G. Sorenson, U.S. Geological Survey; William Acevedo, U.S. Geological Survey*

Two of the United States Geological Survey's (USGS) land cover products are the Land Cover Trends Project (LCT), a sample-based, manual classification, and the National Land Cover Dataset (NLCD), a wall to wall, semi-automated classification. A comparison of each LCT sample block with the same area in NLCD 2001 land cover data was performed. The two hundred blocks that showed the most disagreement (97.7 to 39.3 percent), then were visually inspected to ascertain which of the two classifications was more correct. Four main areas of disagreement were observed. 1) LCT classifiers with limited familiarity of certain regions made mistakes. 2) The same Landsat images were not always used by both projects, so recent change may not have been captured by both processes. 3) The Landsat sensor had difficulty in distinguishing between certain classes. Examples of the confusion were between pasture and grassland, between forest and wetland (especially forested wetlands) and between barren and grassland. 4) The final major disagreement was differences in class definitions and procedures. NLCD and LCT had different forest definitions, which resulted in more LCT forest, plus tidal areas were sometimes treated differently.

Integrated landscape ecological knowledge in landscape planning

Zhifang Wang Associate Professor College of Architecture and Landscape Architecture Peking University

The goal of landscape planning is to create functioning ecosystems for both nature and human well-being. In deprived regions with rapid urbanization pressure, successful landscape planning depends on the integration of ecology, livelihoods and traditional ecological knowledge (TEK). this study proposes an interdisciplinary research framework to plan green infrastructure for stormwater management based on ecological data, TEK and social needs. The study site with serious stormwater challenges and urbanization pressure locate at Liangjiang District, Chongqing, Sichuan Province. Scientific data and models provide basic stormwater and ecosystem assessment. PPGIS with semi-structured questionnaires are used to collect local knowledge about vernacular landscape pattern, landscape changes, assessment of local ecosystem functions and preferences for future development. Local people involved include both government offices and residents with different knowledge about the past, the landscape and the future. The final green infrastructure plan integrates scientific and local ecological knowledge as well as the sociopolitical realities of the local communities. Vernacular landscape structure, pond-paddy field, is considered as the basic structure for future green infrastructure together with modifications for future social needs and ecosystem functions. The planning process aims to achieve multifaceted integrations, including social and ecological values, research and practice, local and scientific knowledge, as well as the past and the future.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Spatial Scaling in Wildlife Conservation: Determining Fine Approaches to Coarse Problems

Steve Zack, Wildlife Conservation Society; Eric Sanderson, Wildlife Conservation Society*

Landscape ecology, as originally framed by John Wiens, has had a rich and constructive history with conservation biology through time. Several early concepts have become central to conservation biology practice including grain and extent, as illustrated by range-priority setting developed by the Wildlife Conservation Society; landscape heterogeneity, as applied by us in Arctic Alaska conservation planning; human influence on landscape structure, illustrated by the human footprint; and restoration of landscapes with an example from our work with restored beaver and songbirds. Confusion and challenges may arise, however, between landscape ecology technical tools that appear informative from a desktop yet find problems in application in the real world of diverse stakeholders engaged in conservation outcomes. Overall, however, our organization and other conservation practitioners have greatly benefitted from applying landscape ecology tenets when addressing important conservation issues in landscapes and with endangered species. Conservation challenges of course continue to grow as the human footprint inexorably expands, begging the question as to what are the next great set of landscape ecology ideas that will help conservation practitioners conserve the natural world?

Understanding interactions among climate change, insect outbreaks, wildfires, and forest management on dry forests in the western US

Robert Scheller, Portland State University; E. Louise Loudermilk, USDA Forest Service*

Understanding how climate change will alter forest carbon in dry forests requires knowledge of forest growth relationships with climate, long-term tree species dynamics, and past and future disturbances, and forest management. Integrating these diverse processes and their complex interactions requires the synthesis of many empirical data sources into sophisticated forest landscape change models. Wildfire and insect outbreaks are correlated with climate change and require special attention when addressing long-term forest management goals. We evaluated the responses of multiple interacting processes: climate change, bark beetle outbreaks, wildfire, and forest management on forest dynamics within the regional landscape of dry forests of the western US. We used the LANDIS-II modeling framework to integrate these diverse processes and project forest dynamics including species composition and forest carbon. We validated our estimates with tree-core and historic fire data. Our simulations indicate that intensive fuels management can create a more fire resilient landscape and increase climate resilience. Climate change will increase drought conditions that will exacerbate bark beetle outbreaks. Although these forests will likely remain a carbon sink, regardless of climate regime, bark beetles add large uncertainty and substantially increased the likelihood that these forests will release carbon to the atmosphere in any given year. Bark beetles did not substantially interact with wildfire, however, and may reduce the need for forest management to create fire resilience. Our results highlight the importance of focusing on long temporal and large spatial-scale processes for understanding climate change effects on forest succession, disturbances, and the carbon cycle.

How to Arrange the Next Billion Urban People and Enhance Natural Systems

Richard T. T. Forman, Graduate School of Design, Harvard University

U.N. projections point to the next billion people coming fast, all effectively urban, and 50% poor. Meanwhile natural systems are widely stressed, disrupted, and inadequate for the present human population. Globally, areas with nature are usefully grouped from highest to lowest value: (a) highest: large natural lands; large natural patches in agricultural land; freshwater and estuarine water-bodies; and vegetation zones alongside water bodies; (b) medium: small natural patches/corridors in

agricultural land; large and small natural patches/corridors in urban land; and (c) lowest: crop/pasture land; built areas. To enhance natural systems (without significantly losing total, and nearby high-quality-soil, agricultural land) means maintaining most, and improving some, of the high- and medium-value natural systems. The key existing spatial patterns for upcoming population growth are: megacities; large cities; small cities (including edge, satellite, and isolated); sprawl areas; strip/ribbon development; towns; villages; holiday-home areas; and undeveloped areas. (1) Targeting growth in large cities, small cities, and sprawl areas may be optimal. (2) Within an urban area, targeting growth in the ring around city center, built suburbia, and exurban/periurban low-quality-soil areas adjoining suburbs may be best. This preliminary solution to the big challenge emanates from ecological footprint analysis, transportation and effects, disasters including wars, human effects at different housing densities, urban effects on water bodies, informal squatter settlement, habitat loss, agriculture and good soils, greenspace arrangement in/around urban areas, and the feasibility of improving natural systems.

Making Landscape Classification Relevant for Agriculture

Sarah C. Goslee, USDA-ARS

Most regional and larger landscape classifications have focused on natural vegetation types, but these broad classifications have potential uses in agriculture as well. Defining a site type in terms of the vegetation it can support, whether natural or managed, can provide an extremely flexible framework to serve as the basis for management. A hierarchical fuzzy classification methodology based on topographic, edaphic, and climatic variables important to the ecological processes delimiting species distributions can define the potential vegetation at a site. State and transition models based on expert knowledge and simulation modeling formalize the relationships between these potential uses and management options. A team of USDA ARS and NRCS scientists and practitioners have been collaborating to identify the necessary components of an agriculturally-relevant landscape classification system. We have completed the first phase of classification for the continental United States, and have compared this classification to existing divisions such as the NRCS's Major Land Resource Area. Site type delineation within this larger continental classification is ongoing, beginning with the northeastern US and expanding westward. The combination of multivariate analysis to simplify complex quantitative data and expert knowledge to facilitate interpretation is a powerful approach to understanding agricultural landscapes and will serve as the basis for national modeling and monitoring efforts.

Nature's shield: coastal habitats protect people and property from sea-level rise and storms

Katie Arkema, Gregory Verutes, Greg Guannel, Jess Silver -The Natural Capital Project Stanford University

Extreme weather, sea-level rise and degraded coastal ecosystems are placing people and property at greater risk of damage from coastal hazards. The likelihood and magnitude of losses may be reduced by intact reefs and vegetation, especially when those habitats fringe vulnerable communities and infrastructure. Yet, understanding where and to what extent ecosystems are most important for defending shoreline communities depends on many factors that vary spatially across coastal land- and seascapes. To address this challenge, we developed a hazard index that synthesizes climate scenarios, shoreline and oceanographic variables, demographic information, and ecological data. We applied this model to every 1 km of the entire coast of the United States. We found the number of people, poor families, elderly and total value of residential property that are most exposed to hazards can be reduced by half if existing coastal habitats remain fully intact into the future. We also found that coastal habitats defend the greatest number of people and total property value in Florida, New York and California. The model is now being used to inform climate adaptation strategies and to prioritize investments in habitats conservation in the United States and around the world (e.g., Belize, Barbados, Mozambique).

We will share results from several applications to highlight where and under what conditions ecosystems play the most important role in enhancing resilience from coastal hazards and climate change.

Urbanization of Playa Wetlands in the Southern High Plains: Present and Future Patterns Under Four Growth and Climate Scenarios

Lucas J. Heintzman, Texas Tech University; Nancy E. McIntyre, Texas Tech University*

Playas are shallow, runoff-fed wetlands of the Southern High Plains (SHP) of North America that are critical habitats for migratory and resident wildlife, in an area projected to experience modest human population growth and modest to severe impacts from climate change over the next century. Many playas have already been modified via urbanization for stormwater management and recreation. However, few studies have examined the important conservation implications of urbanization on playas, and limited knowledge exists of the expected rates of future playa urbanization under different growth and climate scenarios. We investigated playa urbanization utilizing a GIS-based model of SHP wetlands and the US Environmental Protection Agency's Integrated Climate and Land Use Scenarios (ICLUS). Projected patterns of urbanization for the SHP (focusing on Lubbock County, Texas) will incorporate portions of the surrounding exurban landscape along with unknown compositions and configurations of non-urbanized playas. Results to date indicate that the pattern of playa urban incorporation is highly variable (with respect to composition, configuration, and connectivity) for each of the four ICLUS scenarios (A1, A2, B1, B2). Highest rates of projected urban playa incorporation are expected under scenario A2. The goals of this project are to aid wildlife and municipal managers' planning and conservation of playa wetlands as conservation concerns for playa wetlands are magnified in light of shifting climate and demographics on the SHP.

Secondary succession trends of mangrove species in planted R. stylosa forest

Takashi Asaeda, Saitama University; Abner Barnuevo, KP Group Philippines; Kelum Sanjaya, Saitama University*

Mono-specific planting of mangroves for rehabilitating the degraded mangrove forests, substantially changes the species composition, tree-density and the landscape. Field investigation was conducted in Olango and Banacon Islands in the Philippines, where Rhizophora stylosa was planted utterly, nevertheless the original species were Avicennia marina and Sonneratia alba. The objective of the study was to investigate the secondary succession process in a planted mangrove forest. Species composition and morphological parameters were measured for all individual trees in randomly selected 5m by 5m quadrats in both planted and natural forests. After planting, the mature tree density of R. stylosa gradually decreased with age. Mature tree density was two to ten times lower in the natural stands than in the planted forests. The coverage ratio of the ground surface by tree canopies gradually increased with tree age, although tree density declined both in natural and planted forest. Seedling and sapling density was raised to its peak with increasing mature tree density of the same species; however the density at the peak was substantially higher in R. stylosa, compared to the other species. The recruitment rate of A. marina and S. alba was significantly decreased with the increasing density of mature R. stylosa. Therefore, we suggests that the planted R. stylosa is essentially larger in density even after subjected to self-thinning, compared to natural forests, and generates young trees. Meanwhile, it inhibits the recruitment of other species and converts the forests in to mono-specific.

How isolation by environment influences gene flow on ecologically complex landscapes

Ian J. Wang, UC Berkeley*

How organisms interact with the landscapes they inhabit has important consequences for dispersal, gene flow, and population structure. Two key patterns of spatial genetic structure that can emerge are isolation by distance (IBD), the correlation of genetic and geographic distances, and isolation by environment (IBE), the correlation of genetic and environmental distances. These patterns can result from a variety of ecological and evolutionary processes, and new studies in ecological and landscape genetics can demonstrate the relative prevelance of these patterns in nature. I will discuss the mechanisms that can generate IBD and IBE and present empirical examples of IBE in several organisms from different ecosystems and different parts of the world. Ultimately, new and increasingly sophisticated studies of IBE in natural systems are poised to make significant contributions to our understanding of the role of landscape ecology in genetic divergence.

Conserving God's Own Country: Biodiversity in Agroforestry Landscapes of Kerala, India

Theraesa Coyle, McGill University; Thomas Fox, McGill University; T. K. Kunhamu, Kerala Agricultural University; Navin Ramankutty, University of British Columbia; Jeanine Rhemtulla, University of British Columbia*

The traditional home gardens of Kerala, India, may offer a sustainable balance between food production and ecosystem conservation. These structurally complex agroforestry systems, situated within the Western Ghats biodiversity hotspot, may provide a safe haven for species threatened by habitat destruction, while still supplying food and income to families. Despite their potential value, these ancient and diverse gardens are quickly disappearing to housing development and monoculture plantations, threatening both biodiversity and food security. Our project explores the ongoing land-use changes in Kerala, the potential of home gardens to support wild biodiversity, and the attitudes of local home owners towards agriculture, wildlife and the environment. We used a combination of sociological and biological field surveys, as well as remote sensing and GIS, to examine 1) the rate of disappearance of home gardens from local landscapes and the corresponding land-use changes, 2) the diversity of birds, amphibians, insects and trees in home gardens and the landscape features which influence it, and 3) the correlations between home owner dependence upon agriculture, land management decisions, attitudes towards environmental issues and the cultivated and non-cultivated diversity on their lands. Our results highlight the importance of conserving traditional farming methods in rural landscapes, and aid our understanding of land-use decisions and their importance for biodiversity.

A multi-perspectival approach for integrative assessment of ecosystem services using Bayesian Belief Networks

Pasicha Chaikaew, Soil and Water Science Department, University of Florida, Gainesville, FL, USA & Department of Environmental Science, Chulalongkorn University, Bangkok, Thailand; Sabine Grunwald, Soil and Water Science Department, University of Florida*

Climate regulation, carbon sequestration, and nutrient cycling ecosystem services are critical to quantify the quality and functioning of ecosystems. Very often ecosystem service measures are based merely on biophysical studies, but those do not necessarily match the values and beliefs people hold about these ecosystem services. Research gaps exist to integrate biophysical, ecological, and socio-economic perspectives across ecosystem domains covering the atmosphere, biosphere, pedosphere, hydrosphere, and anthroposphere. This study presents a framework to bundle and harmonize 'biophysical and ecological' and 'human perceived benefits'. Our specific objective was to synthesize interactions between ecosystem services under different scenarios. We employed a Bayesian Belief Network (BBN) model that included important system variables and beliefs derived from empirical observations,

statistical and quantitative assessments, socio-economic survey results, literature, and expert knowledge. Four distinct scenarios were considered: Grow with Awareness (GA), Gain Economic value (GE), Go toward the Protection (GP), and Business as Usual (BU). A parameter sensitivity analysis revealed the sensitivity of variables towards the selected ecosystem services. The scores of the BBN assessing ecosystem services ranked as following: GA (62.74) > BU (48.73) ~GP (48.51) > GE (-59.08). Scenarios represent imagined possible future outcomes that are highly influenced by the perception and valuation of people, public awareness, decision making, and politics. Focusing on awareness enhancement rather than economic growth allows more room for improving the environment and benefits people derive from them. The synthesis of different realms and perspectives made this BBN ecosystem service study more holistic when compared to more one-sided environment investigations.

Group Discussion

Hong S. He, School of Natural Resources, University of Missouri; Wen J. Wang, School of Natural Resources, University of Missouri; Frank R. Thompson, USDA Forest Service Northern Research Station; Jacob S. Fraser, School of Natural Resources, University*

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The Landscape metabolism: a new cross disciplinary conceptualization.

Luis Inostroza, Institute of Photogrammetry and Remote Sensing, Technische Universitat Dresden

In times of global process of urbanization, typical rural-urban dichotomies are diluting, losing explanatory power. Landscape ecology has to deal with the increasing irruption of different technological elements - green, blue, grey nexus in landscapes. Cities are expanding at rates higher than most geographic landscape forces. The need to include technological elements in spatial planning and landscape assessment is increasingly being accepted. Nevertheless, new methods, theoretical frameworks and tools to assess these challenges are needed. Ecotopes are different than technotopes, the new hybrid homogeneities resulting of technological elements embedded in landscape's compartments. The increase in the pace at what technological materials are being stocked in landscape compartments is asking for the inclusion of metabolic assessment, to better understanding of current landscape changes and drivers. The technomass is growing at fast rates, as statistics of urban expansion, stocks and global demand of materials have shown. It is necessary to put together different disciplinary approaches to better understand the growing role of technological elements as driving forces changing landscape structure, pattern and processes, to outline a techno-metabolic approach, aiming a better understanding of current disciplinary as well as conceptual, methodological and operational challenges in an urban world.

Research on Cooperative Relation of Non-agricultural Habitats and Soil Animals in Suburban Farmland Landscape

Bian Zhenxing,College of Land and Environment, Shenyang Agricultural University; Yu Miao*,College of Sciences, Shenyang Agricultural University; Wang Qiubing,College of Land and Environment, Shenyang Agricultural University;Li Jinhong,,College of Land*

Modern agriculture has more and more characters of industrialization and high yield.It`s often neglected that the biodiversity in farmland has been simplified and the function of biodiversity has been weaken.There are plentiful rarespecies in non-agricultural habitats in farmland landscape. Non-agricultural habitats are very important for the biodiversity conservation, landscape structure and agricultural yield.When people demand more and more high yield,non-agricultural habitats have been

reduce or disappear.This phenomenon is common in Suburban Areas,China. In this paper, information entropy model, hand-picking and stereo microscope were been used. Shenbei New District in Shenyang City,Liaoning Province,Northeast China was divided into urban areas(UA),urban fringe areas(UFA) and rural areas(RA).The cooperative relations of non-agricultural habitats and soil animals in farmland landscape were studied under urban UA,UFA and RA in Shenbei New District.The results show: (1) With urban distance,the proportion of non-agricultural habitats patch is 8.60% to 27.78% and the proportion of non-agricultural habitats areas is 0.01% to 0.89%.The type of non-agricultural habitats is woodland in UA ,are grassland and water area in UFA and are grassland, woodland, water areas and country roads in RA.(2)The individual number of soil animals is increase with the proportion of non-agricultural habitat patch increasing in RA.The relation of similarity appear in UA.There was no obvious correlation relation between the individual number of soil animal and the proportion of non-agricultural habitat patch in UFA.The reason that is the farmland landscape fragmentation by urbanization.The farmland landscape patterns in UA are become better to better after urbanization. The farmland landscape patterns in UFA are go from bad to worse in urbanization. The farmland landscape patterns in RA are connectivity and integrity. (3)The individual number of soil animals in farmland landscape with urban distance showed the U-type trend,when the proportion of non-agricultural habitat areas with urban distance showed the upside down U-type trend. This study conclusion is not identical to the positive relation of the proportion of non-agricultural habitats areas and the individual number of biology in farmland that has been proved by Schmidt in 2005. Investigate its reason mainly is disturb,lack or disappear of biodiversity function of non-agricultural habitat due to the different intensity and way of human activity in non-agricultural habitat.(4)There are no the cooperative relations in the proportion of non-agricultural habitats and the number of species of soil animals.The possible cause of this situation is that the urbanization in Shenbei New District has been in short time.There is no obviousÂ change for the number of species of soil animals.(5)In order to increase the biodiversity and heterogeneity of non-agricultural habitats in suburban areas, this paper propose to build the non-agricultural habitats and to limit the low proportion of the non-agricultural habitats areas,types and structure during farmland consolidation.

Impacts and causes of sudden salt marsh dieback in the Mississippi River Delta landscape

Irving A. Mendelssohn, Louisiana State University; Karen L. McKee, United States Geological Survey; Qianxin Lin, Louisiana State University; Raymond W. Schneider, Louisiana State University*

Ecological disturbances can dramatically alter natural landscapes, causing shifts in ecosystem state, structure, and function. One type of disturbance, extreme weather, may increase in intensity during the 21st century due to global climate change. A large-scale, drought induced disturbance occurred in the Mississippi River Delta salt marshes during the spring and summer of 2000. This record-setting event resulted in the dieback of ca. 43,000 hectares of Spartina-dominated salt marshes. Sudden salt marsh dieback has been documented in at least 10 other states, including South Carolina and Georgia where drought was again the likely ultimate cause. However, the proximate cause for plant impact was not apparent. Therefore, via a series of field, laboratory and greenhouse investigations, we assessed the influence of abiotic and biotic controls on plant and soil chemical responses that could provide insight into causation. We found that at a non-lethal pH of 3.0, a pH that could have occurred during the dieback event, and in the presence of Fe and Al, even at non-lethal concentrations, plant mortality ranged from 40 - 60%. Further stress in the form of a sublethal water deficit, and possible associated fungal pathogenicity, resulted in an increase in Spartina mortality to nearly 90%, Our research supports the hypothesis that low precipitation and reduced marsh flooding during the dieback event induced soil oxidation, soil acidification, and metal toxicity, acting in conjunction with plant water stress (possibly exacerbated by elevated rhizosphere soil salinities), to cause plant mortality.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Impact of the Spatial Arrangement of Agricultural Land Use on Ecosystems Services and Peri-Urban Livelihoods at the Landscape Scale.

Justice Nana Inkoom, Centre for Development Research; Christine Furst, Centre for Development Research; Susanne Frank, Centre for Development Research.*

The relationship between Agricultural Land Uses (ALU) and their impact on Ecosystems Services (ES) including biodiversity conservation is complex. This complexity has been augmented by isolated research on the impact of ALU on the landscape's capacity to provide ES in most vulnerable areas of Sub-Saharan Africa. Though a considerable number of studies emphasize the nexus between specific land use types and their impact on ES, a sufficient modelling basis for an empirical consideration of spatial interactions between different agricultural land uses at the landscape scale within peri-urban areas in Sub-Saharan Africa is consistently missing. The need to assess and address landscape characters regarding size, shape, and interactivity of different land use patches in assessing land use interactions and their impact on ecosystem service provision necessitated this investigation. To formulate a methodology to correspond to this complexity, ES obtained from a characteristically agricultural and urbanizing landscapes were mapped using analytical hierarchical processes and management expert approaches. Further, landscape metrics and mean enrichment factor approaches are explored as neighbourhood assessment tools aimed at assessing the mutual impact gradient of agricultural and adjacent urban land uses on ES provision. Implementation is undertaken in GISCAME using a 2012 RapidEye image classification and primary data collected on selected ES from local farmers within the VEA catchment of Upper East, Ghana. The outcome aims to provide the understanding of expected trade-offs and synergies that interacting ALU pose to current and potential ES provision within rural landscapes. Final results will inform ALU and landscape management decisions.

Resistance surfaces for understanding species movement: what do they tell us about connectivity of large carnivores?

Elzbieta Ziolkowska, Jagiellonian University; Katarzyna Ostapowicz, Jagiellonian University; Volker C. Radeloff, University of Wisconsin-Madison; Nuria Selva, Polish Academy of Sciences; Tobias Kuemmerle, Humboldt-University Berlin; Wojciech Åšmietana, P*

Connectivity assessments typically rely on resistance surfaces that are derived from habitat models, assuming that higher-quality habitat allows for easier movement. That may be problematic however, because habitat suitability may not adequately reflect how the environment affects animal movement. In this study, we investigated how much connectivity analyses differ when relying on resistance surface from habitat suitability versus movement models using telemetry data from brown bears (Ursus arctos) in the Northeastern Carpathians. Our results showed substantial differences in the connectivity estimates based on habitat suitability and movement models, as well as in the environmental factors and functional scales which determined habitat suitability versus movement probabilities. Resistance surfaces based on habitat suitability were likely to underestimate connectivity, and predicted substantially higher resistance values for most of our study area. Furthermore, we showed that corridors generated based on the habitat suitability model were shorter, less tortuous, and characterized by higher resistances than those delineated based on movement models. Connectivity analysis based on habitat suitability models can thus misinform management decisions related to corridor protection. Our findings highlight the importance of including movement data when parameterizing resistance surfaces.
We gratefully acknowledge support by the National Science Centre [project no. 2011/03/D/ST10/05568].

Diversifying Managed Forests to Increase Resilience

Caren Dymond, Sinclair Tedder, Dave Spittlehouse, Brian Raymer, Katherine Hopkins, Katharine McCallion, James Sandland -Government of British Columbia*

Increasing species diversity is frequently mentioned as a way to increase ecosystem resilience to climate change impacts - essentially hedging our bets. But theories need to be tested. In British Columbia, Canada, a recent epidemic of mountain pine beetle caused widespread forest mortality. This epidemic was due in part to the changing climate, and damage from pests and diseases is expected to increase in the future. Therefore, we used a historical retrospective approach as a proxy to evaluate management options on reducing the forest health risks and socio-ecological resilience. We assessed three landscape-scale strategies from 1980 to 2060, including the 1999-2012 beetle epidemic. Two strategies were intended to increase tree species diversity as one aspect of ecosystem resilience. We compared these with the business-as-usual strategy. The assessment was based on simulation modelling of the Merritt Timber Supply Area for 1980-2060. We applied a strategy to increase the harvest of the most dominant tree species, plant more diverse species, and increase natural regeneration. This strategy resulted in greater ecological resilience (higher diversity and growing stocks), higher harvest rates, more old-growth, and higher, more consistent net revenue over time than the business-as-usual strategy or the strategy that only employed a diversity of planting. The second resilience-oriented strategy did not affect the impact of the beetle. A sensitivity analysis indicated a high level of robustness in the results. Our study demonstrated that there are economically feasible options for climate change adaptation through forest management.

Changes of landscape quality in coastal zone, Eastern China

Qiqi Wang, School of Geographic and Oceanographic Sciences, Nanjing University, China*

With the development of coastal regions and rapid urbanization, construction land continuously expanded to coastal wetland in China, meanwhile the ecological stability of coastal landscape is facing an enormous pressure at these regions. In this paper, we build an Assessment Model of Landscape Quality (AMLQ) based on ecosystem stability and anti-disturbance ability to analysis the changes on quantity and quality of coastal district landscapes at Jiangsu Province, China from 1985 to 2010. The results show that: 1) the areas which are stable and relative stable cover 57.3% in 1985 and increase to 70.8% in 2010 accompany with upgrade of landscape quality (LQ); 2) coastal region has higher stability and LQ decreases with the distance from the sea; 3) regional landscape quality is not only affected by landscape structures, patterns and also by water environment at wetlands; 4) Different levels of urbanization significantly affect regional LQs, higher urbanization regions have lower LQs, which means rapid urbanization limits the rise of LQ.

Modeling habitat connectivity and identifying potential barriers to puma movement across the state of Arizona

Meredith McClure, Conservation Science Partners; Brett Dickson, Conservation Science Partners; Kerry Nicholson, Alaska Department of Fish & Game*

In the face of an expanding human footprint, maintaining connectivity for wide-ranging species such as pumas (Puma concolor) is of increasing conservation concern. Although pumas are distributed throughout much of the western United States, their habitat is often restricted to mountain ranges embedded in a matrix of urban or uninhabitable areas. Continued wildland-to-urban conversion results in loss and fragmentation of puma habitat. For 28 pumas monitored around three urban centers in Arizona, we applied novel methods to estimate habitat connectivity and evaluate potential impacts of landscape modification on puma movement risk. We fit Brownian bridge movement models permitting

fine-scale, probabilistic estimates of space use during movement between relocations. We then used multi-model inference to fit a linear mixed model of space use intensity conditioned on multiple habitat and landscape features, including degree of human modification. Finally, we used an omnidirectional implementation of circuit theory to predict habitat connectivity across the state, and assessed the status of connectivity â€˜pinch pointsâ€™, or bottlenecks, in the context of 1) land development potential, 2) roads and traffic volume, and 3) current and proposed border security measures. Results indicated that pumas avoided movement through highly modified areas, while areas of high topographic roughness and cover were used more intensively. Our statewide connectivity model identified places where connectivity is expected to be most impacted by high-volume roads, expanding human settlement, or continued fortification of the U.S.-Mexico border. We highlight these bottlenecks as priorities for maintaining puma connectivity in one of the fastest-growing regions of the country.

Pre-settlement vs. modern fire regimes of the Sierra Nevada, California, USA

Jay Miller, USDA Forest Service, Pacific Southwest Region*

Land use practices and fire suppression have changed forest structure and impacted ecosystem function in western US forests that historically experienced frequent fire. Objectives for restoration remain somewhat uncertain, especially with the recent emphasis on early seral at the expense of discounting late seral forests. We compare pre-settlement and modern fire regime attributes for forests of the Sierra Nevada region of California. Late 20th century average fire size is smaller compared with early 20th century and in Yosemite National Parkâ€™s fire use fires, but area weighted mean is almost five times larger. For lower elevation yellow pine/mixed conifer forests, the area burned at high severity (stand replacement) over the past few decades (1984-2009) is within the range of estimates for pre-settlement forests. However, there is a deficit of surface and mixed severity fire. Model results demonstrate that significant extents of these forests could not have been in late seral condition if the modern proportion of high severity was typical during pre-settlement times. Fires and fire effects over the last 25 years do not appear to be typical of the pre-settlement fire regime of Sierra Nevada forests.

The landscape gardeners: a typology of farmers in the Maningory watershed, Madagascar

Annick Ravaka(1), Patrick O. Waeber(2), Harifidy Rakoto Ratsimba(1), Lucienne Wilme(3), Bruno Ramamonjisoa(1) 1: ESSA-Forets, Antananarivo, Madagascar 2: ETH Zurich, Forest Management and Development, Switzerland 3: Missouri Botanical Garden, Antananar, M

Agriculture is the main source of livelihood and income for many rural people. Globally, some 500 million peasants provide food for more than two billion people. The tropics are home to about 40% of the world population of which a majority is making a livelihood through farming. In Madagascar, over 75% of the population engages in farming contributing to more than 26% of the country's GDP. The Maningory watershed encompasses the Alaotra and Analanjirofo regions, renowned as main rice and cash crops producer, respectively. The landscape is a mosaic of open grasslands, humid forests and degraded humid forests and wetlands. Main land-use activities consist of agriculture (rice and cash crop systems) and energy production (wood and charcoal sourced mainly from eucalyptus and acacia plantations). It is hypothesized that individual agricultural practices and inherent decisions are shaping a landscape. We have developed a typology (T) of the main actors of the Maningory socio-ecological system. T1represents a landowning farmer producing mostly rice; T2 is a seasonal worker investing to equal accounts in rice and cash crop production; T3, also a landless farmer, is an opportunist in constant search for new alternatives and geared towards energy production and mining opportunities. How are individual decisions on land-type use influenced by market effects and migration? These information are fundamental to the participatory modelling approach (Companion Modelling) deployed in this research

for the development and testing of role playing games to understand future landscape trajectories, to better balance food and energy needs with biodiversity values.

Plenary Discussion with all presenters: Usability and Uptake of Tools and Instruments

Marc J. Metzger, The University of Edinburgh

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Characteristics of spatial distribution pattern and change of urban land use and population: Case study of the entire national land of Japan

Hiroyuki Shimizu, Professor, School of Environmental Studies, Nagoya University*

Expansion of urban land use has affected the wide range of ecological systems. Urban landscape changes might be related to population changes. There are few research studies and reports on land use changes related to population changes on a wide scale such as the national level. This presentation shows the characteristics of spatial distribution patterns and their change of urban land use and population in the entire national land of Japan by using 1 km mesh analysis on GIS. We termed it "shrinking", as the population stabilizes or decreases and urban land use decreases, "scattering" as the population decreases and urban land use stabilizes or increases, "expanding" as the population stabilizes or increases and urban land use increases, or "compacting" as the population decreases and urban land use decreases or stabilizes. The following facts are clarified; there are many scattering areas around big cities where urban land use is increasing even though population is decreasing, and there is a mosaic structure of shrinking, expanding and scattering in the peripheral areas away from the city center. It is also clarified that the land gradient regulates the development of urban land use, and land use of paddy and crop fields can easily be changed to urban land use. Even when there is a tendency for the population to shrink, land use "scattering" and partially "expanding" might continue in flat lands and in the long term continued traditional ecosystem services in paddy fields might continuously decline.

Quantifying past forest disturbance severity: Linking a new historical data set and field methods

David J. Mladenoff; Jodi A. Forrester; Matthew Noone, Dept of Forest & Wildlife Ecology, University of Wisconsin-Madison.*

We are using newly digitized comprehensive land cover maps of Wisconsin for the 1930s to estimate the history of forest disturbance severity, and linking this with field sampling of resulting effects on soil carbon and forest productivity. Growing evidence tells us that severe forest disturbances have long-term legacy effects on soils and subsequently regenerated forests. In order to understand the severity of forest disturbances following original logging of forests in the Northern Lake States, systematic data are needed for the post logging early 1900 period. Such data seldom exist. In Wisconsin a detailed landscape survey was done from the late 1920s to 1940, known as the Bordner Land Economic Inventory. We are engaged in a large-scale effort to digitize these maps for the entire state. Recorded burned areas, abandoned farms, and areas regenerating to fire species such as aspen, tell us of the relative severity of post logging disturbance. We have quantified these mapped changes and characterized their effects. The result is being further used to guide selection of study sites for a detailed examination of changes in forest soils, growth and productivity.

Functional connectivity of urban green spaces for insectivorous bat species

Marcela Suarez-Rubio, Institute of Zoology, University of Natural Resources and Life Sciences; Frederick Sprick, Institute of Zoology, University of Natural Resources and Life Sciences; Alexander Bruckner, Institute of Zoology, University of Natural Reso*

Urbanization transforms natural habitats into fragmented landscapes leaving urban green spaces as sole remaining habitats. Urban green spaces not only sustain a diverse spectrum of organisms, but also provide important environmental services and improve quality of life. Despite high conservation status and ecological importance of bats, little is known about bats' activity patterns and habitat use in urban green spaces. We determined activity patterns of insectivorous bats in urban green spaces and assessed whether these spaces constitute a network that would enable bats to move between remaining habitats and access resources. We recorded bat calls using stationary echolocation detectors at 106 sites in parks and residential yards across the city of Vienna, Austria. Using the proportion of land cover surrounding the sampling locations within varying buffers, we estimated a distinctive threshold distance or "foraging" range of common bat species and assessed relative connectivity of urban green spaces. We identified calls of 12 bat species and three species groups in which the most common species were Hypsugo savii, Nyctalus noctula, Pipistrellus pygmaeus, P. pipistrellus and the P. kuhlii-P. nathusii group. Assessment of functional connectivity using a 500 m threshold distance showed that small urban green spaces serve as important stepping stones between larger green spaces suggesting that managing urban green spaces could alleviate the ecological impacts of habitat fragmentation caused by urbanization.

Bioregional planning for multiple aggregate site rehabilitation

Heather Schibli, Landscape Architecture, University of Guelph; Dr. Karen Landman, School of Environmental Design & Rural Development, University of Guelph, Guelph Ontario; Dr. Lorne Bennett, Department of Geography, College of Social and Applied Human Sc*

A collaborative project between industry, environmental groups, and government resulted in a bioregional plan for the rehabilitation of multiple aggregate sites in the Township of Uxbridge, Ontario. The research aims were to extract the industry's best practices from the grey literature and to apply these practices, along with the bioregional plan goals, to conceptual landscape designs that were then used as an engagement tool for landscape stakeholders. The best practices, the bioregion plan goals, and inventory and analysis of the landscape were synthesized to develop alternative landscape scenarios. Stakeholders reviewed and discussed these scenarios, revealing different values and perspectives. Discussion and assessment lead to common ground and continued development of bioregional landscape solutions. This process can be a model for rehabilitation planning in other aggregate-rich municipalities.

Surface water networks - examples from down under

Mirela Tulbure, University of New South Wales; Stuart Kinninmonth, Stockholm University; Mark Broich, University of New South Wales*

The concept of habitat networks represents an important tool for landscape conservation and management at regional scales. Graph theory is a powerful approach for assessing connectivity across scales and time. Few studies have quantified the naturally occurring spatiotemporal dynamics of networks with the majority of studies assuming a fixed network structure through time. This is particularly of concern for aquatic systems, which typically show high natural spatial and temporal variability. In this talk we will focus on analyzing surface water networks in Australia. Examples will include dynamic surface water networks derived using Landsat data from 1999-2011 over one of the 25 global biodiversity hotspot in the Southwest of Australia that is subject to fast urban expansion, high

rates of ground water extraction and a drying climate. Results showed high temporal variability in network topology metrics. A decline in connectivity over time was noted suggesting that the overall connectivity of the landscape has decreased from 1999 until 2011, with potential negative consequences for species with limited dispersal capacity. Identifying surface water bodies that act as 'stepping-stones' and network 'hubs' is important for prioritizing areas in need of conservation, but also for areas that serve as hubs for invasive species dispersal.

Diversity of ecosystem services in European cities: Patterns of demand and supply

Dagmar Haase, Neele Larondelle, Nadja Kabisch Humboldt Universitat zu Berlin and Gelmholtz Centre for Environmental Research - UFZ

This paper presents the first analysis of the diversity of ecosystem services (ESS)-key variables for global environmental sustainability and change in an urban era-across a globally important part of the urban world, urban Europe. We analyze and map the first pan-European pattern of ecosystem services supply in urban core areas and their associated hinterlands and discuss data against the background of each city's land-use development history and planning culture. And we compare this supply with existing demand using urban census data. Upon selecting more than 300 cities, we used the Urban Atlas database and a straightforward calculation method to map three regulating ecosystem services. The main results of this study show (a) a heterogeneous distribution of regulating ecosystem services across European cities, (b) considerable provisioning as well as demand differences between the core cities and their hinterland, (c) a grouping of European regions according to their potential for urban ecosystem service demand-supply relations and (d) an ecosystem services demand-supply ranking for European cities. Considerable differences in urban ecosystem services were found among northern countries, such as Sweden and Finland, which are rich in supplying ecosystem services compared to the UK and Belgium, which, similar to Spanish and Greek cities, are characteristically low in ecosystem services supply but have a high inner-urban demand on them. Our results provide the first overall picture of regulating services in urban EU-Europe and serve to inform decisions on the key aspects of future European policy and strategies involving urban nature, green spaces and health.

Discussion

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Landscape ecology in regional contexts: American, European, and Chinese perspectives

School of Life Sciences and School of Sustainability, Arizona State University and Center for Human-Environment System Sustainability (CHESS), Beijing Normal University

Most if not all landscapes surrounding us are "cultural landscapes" in which people actively interact with the environment. In other words, landscapes are coupled human-environment systems that foster co-evolving nature-culture relationships with place-based signatures. Landscape ecology, as an interdisciplinary science seeking to understand and improve the ecology and sustainability of landscapes, has been influenced inevitably by its regional contexts. In this presentation, I will discuss the historically renowned but currently vanishing differences between the European and North American perspectives, and examine how a Chinese perspective has emerged since the 1980s when modern landscape ecology mushroomed across the world. The key question that I will address here is: How do European, American, and Chinese perspectives in landscape ecology compare and contrast in terms of theory, methods, and research priorities? Difference is not deficiency, and diversity is not divergence. A

pluralistic approach must be embraced if landscape ecology is to achieve its ultimate common goal: landscape sustainability.

Interaction of vegetation, soil and runoff in semi-arid landscape

Li Chen, Desert Research Institute; Shai Sela, Ben Gurion University of the Negev, Israel; Tal Svoray, Ben Gurion University of the Negev, Israel; Shmuel Assouline, A.R.O. Volcani Center, Israel*

The rainfall-runoff process is of critical importance for ecosystem sustainability in semi-arid regions. Recent studies have disclosed complex feedbacks between water, vegetation patches, topography and soil characteristics. In such environments, this process is greatly affected by several common factors, including topography, vegetation patches, and surface sealing. The widely observed soil surface sealing complicates impact of topography and vegetation on runoff generation processes. Soil surface sealing involves the formation of a compact seal layer at the vicinity of the soil surface, inducing a drastic reduction of the soil inï¬ltrability, which alters the local rainfall-runoff relationship. To quantify the interplay of surface sealing, microtopography and vegetation in semiarid region hydrology, a modeling approach is developed which couples a two-dimensional surface runoff model and a two-layer conceptual inï¬ltration model, and also includes elaborate numerical treatment to study the rainfall-runoff process with the presence of a seal layer. Modeling analyses indicate that the seal and vegetation are major controls of the runoff generation process and runoff amount, while microtopography significantly affects the spatial pattern of overland flow and runoff routing. More importantly, vegetation patches can receive much more water through surface runoff than rainfall provides, which implies an important mechanism for water resources allocation in dryland ecosystem. In addition, vegetation pattern plays an important role for water resources distribution in this system. Multiple scales analysis shows that runoff exhibits a decreasing trend with increasing spatial scales, while infiltration may vary with scales in a more complex manner, indicating a more intricate ecology-hydrology interaction in large spatial scales.

Impact of Plant Height and Irrigation on Thermal Performance of Extensive Green Roofs in Riyadh City

Ashraf Muharam: Student at Master Program, Department of Architecture & Building Science, college of Architecture and Planning, king Saud university, Saudi Arabia, Email:ashraf.muharam@yahoo.com. ElSayed Amer: professor, Department of Architecture & Build

Increasing worldwide environmental concerns (Global warming, depletion of natural resources, acidrains, air and water pollutions, and ozone depletions) have led to the development of environmentally friendly construction practices. Green roof is one of the sustainable practices for reducing the environmental impact of a building. The study aim was identifying the impact of plant height and irrigation on thermal performance of an extensive green roof system in Riyadh city influenced by tropical and harsh climate. The experimental validations were applied on residential building in Riyadh city during the summer season in 2014. The experimental validations results indicated that the tall grass with average height from 6 to 15cm can reduce the temperature of internal air from 0.5 to 1Â°C, in comparison to the short grass with average height from 3 to 6 cm in similar conditions. While, the temperature of internal air differences were of 0.0Â±0.5Â°C with regular irrigation or irregular irrigation. However, when irrigation stopped more than two days, the grass would wither. Finally, this study has demonstrated that the grass height was more effective for its impact on the thermal performance than regular or irregular irrigation.

Landscape Connectivity in Tabasco

Lilly Gama Campillo, (Universidad Juarez Autonoma de Tabasco) Coral Jazvel Pacheco-Figueroa (Universidad Juarez Autonoma de Tabasco) Elias Jose Gordillo-Chavez (Universidad Juarez Autonoma de Tabasco) Eduardo Javier Moguel-Ordonez (Universidad Juare

Habitat loss and fragmentation are recognized worldwide as threats that severely affect biodiversity. Biological corridors had been established as a valuable tool for conservation efforts. Tabasco, is located within the Mexican area of the Mesoamerican Biological Corridor and it is currently being operated based on priority microregions, without a real biological corridor delimitation. This study had the objective of recognized viable vegetation fragments for corridors to make a cartographic delimitation at landscape level within the state. The vegetation and land use of the area was delimited from the digitization of a 2008 Spot satellite image that was classified using the ArcGis 9.3 software, on a 1:10 scale with field verifications on 2010 and 2011. Bennet's (2004) criteria were used for the delimitation of the biological corridors, linking patches of natural vegetation bigger than a 100 ha. with and more than 1 km and less than 5 km. distance between points. The delimitation consisted of a score taking into account their size, shape and percentage of openings, with the rank of score of 1 to 10, those fragments with score that where between 0 and 5 were categorized as links and those between 5.1 and 10 as nodes. 27.483 fragments were identified but only 5.750 fulfill the conditions to be considered as nodes or links. Forty corridors were delineated that includes 575,789.11 ha. The aim of this research is to serve as a base to be used by state and federal authorities for the establishment of the biological corridors on Tabasco.

Synthesis and Next Steps

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Multi-scale network analysis of wood frog connectivity in Colorado"

Melanie Murphy, University of Wyoming Rick Scherer, Colorado State University Erin Muths, USGS Sara Oyler-McCance, USGS*

A critical need in landscape genetics is to incorporate use of multiple scales into connectivity assessments. To address this need, we aim to quantify the impact of landscape composition, configuration and scale on population connectivity of wood frogs in Northern Colorado. Wood frogs in Colorado are a remnant population that are depended on aquatic systems for breeding but may use terrestrial habitats for dispersal. Connectivity may be influenced at multiple scales both at sites (wetlands) and between sites (connections). We use gravity models to predict flow through a network wetlands based on landscape characteristics. We surveyed wetlands in a high mountain basin adjacent to Rocky Mountain National Park, collecting microsatellite genotype data (8 loci) from adults and tadpoles. Using a Bayesian genetic clustering algorithm, STRUCTURE, we found significant genetic structure. We find that population connectivity is negatively influenced by hydrologic modifications, exposed areas, and roads. Population connectivity is positively influenced by water quality and distance to a source population.

Determining the mechanism of impact of hardwood content on spruce budworm defoliation of balsam fir

Bo Zhang, University of New Brunswick; David A. MacLean, University of New Brunswick*

Balsam fir (Abies balsamea (L.) have lower susceptibility and vulnerability during spruce budworm (Choristoneura fumiferana (Clem.)) outbreaks in forest stands and landscapes with higher hardwood content than in fir-dominated stands. Hardwood content >40% is an apparent threshold that reduces budworm-caused fir defoliation. Studies have shown that cumulative fir mortality decreases with increasing hardwood content, and budworm-caused growth reduction of fir decreased from ~40% when hardwood content of surrounding landscapes was <50% to ~20% when hardwood content was >50%. The hardwood "protective" effects have been attributed to higher parasitism rates of budworm and/or greater larval dispersal losses with higher hardwood content. We are conducting field research to test whether the hardwood "protective" effects are caused by parasitism activity and/or larval dispersal effects in a spruce budworm outbreak that began in 2013 near Amqui, Quebec. Twenty-seven plots were sampled representing a gradient of fir-hardwood stands: three hardwood classes (0-25%, 40-65%, and 75-95%), three stands per class, and three 0.05-ha plots per stand. Within each plot, balsam fir defoliation, budworm population at six life stages, parasitism rates of budworm, and dispersal losses of first and second instar larvae were measured. Results based on year 1 (2014) data showed that balsam fir defoliation and budworm population level were significantly different among the three hardwood content levels. It also showed a trend that both egg parasitism rates and L1 dispersals were the highest in stands with 40-65% hardwood. We will review and discuss the published evidence for effects and mechanisms behind hardwood effects on fir defoliation.

Simulating wolf-moose-forest trophic interactions at Isle Royale National Park-application of the LANDIS-II Browse Disturbance Extension

Nathan R. De Jager, Jason J. Rohweder, Timothy J. Fox -U.S. Geological Society; Mark C. Romanski, National Park Service; Brian R. Miranda, Brian R. Sturtevant -U.S. Forest Service*

Large herbivores are major drivers of terrestrial ecosystem structure and function. Their foraging activities influence forest productivity, successional trajectories, nutrient cycling, and fire regimes. Isle Royale National Park is heavily influenced by one of the highest moose population densities in the world. With recent declines in the island's only predator population (wolves) and concerns about their eventual extinction, future interactions between the moose population and the island landscape could be much different than they are today. We used a newly designed LANDIS-II browse disturbance extension to model reciprocal interactions between the moose population and forest growth and composition on Isle Royale under different wolf management scenarios (high, low and no wolf population). Initial results indicate that the extension is able to reproduce estimates of forage biomass and moose population density that are comparable to field estimates. Increases in the wolf predation rate generally cause a decline in the moose population and delay the onset of population increases at low densities. Such population-level effects influence local browsing rates on the most highly preferred species (aspen, birch, and balsam fir) and modify spatial patterns of forest composition.

Grassland bird occupancy of remnant prairies in Minnesota, North Dakota, and South Dakota influenced more by landscape factors than local factors

Brett J. Goodwin, University of North Dakota, Biology Department; Jessica L. Shahan, University of North Dakota, Biology Department*

We investigated the impact of both local and landscape variation on grassland bird presence in northern tall-grass prairie using a focal patch approach. Bird counts were conducted on 29 remnant prairies in North Dakota, South Dakota, and Minnesota. We analyzed just species found on 11 to 20 of the 29 sites surveyed (American Goldfinch - Carduelis tristis, Barn Swallow - Hirundo rustica, Grasshopper Sparrow - Ammodramus savannarum, Le Conte's Sparrow - Ammodramus leconteii, Sedge Wren - Cistothorus

platensis, Upland Sandpiper - Bartramia longicauda, Cliff Swallow - Hirundo pyrrhonota, Marsh Wren - Cistothorus palustris, and Western Meadowlark - Sturnells neglecta). At each site we measured vegetation structure using a Robel pole and surveyed the percent coverage of vegetation classes (grass, forbs, trees, shrubs, and bare ground). Remnant size and land-cover on the remnant (grass, woody vegetation, vegetated wetlands, open water) were measured from aerial photos. Landscape characteristics were quantified at different distances (0.5, 1, 2, 3, 4 km) from the edge of the remnant using digitized aerial photographs. For each bird species, we constructed multiple-logistic regression models relating presence to all combinations of local and landscape variables and used multi-model inference to identify the sub-set of models with the greatest support. For seven species landscape variables were more important than local variables. Furthermore, landscape variables at greater distances were more important than those at shorter distances. Our results indicate that landscape factors at large distances need to be considered when assessing the suitability of a prairie remnant for grassland bird species.

The best of both worlds: integrating data sets across scales with hierarchical Bayes models to predict species distributions and scenarios of landscape change

Mauricio Nunez-Regueiro, University of Florida Robert J Fletcher, Jr., University of Florida Daniel Greene, University of Florida Robert A. McCleery, University of Florida

Models of species distributions are often developed at two distinct scales. Coarse-scale models typically use information-poor data (e.g., presence-only data) to predict relative distributions across geographic ranges, whereas fine-scale models typically use richer information (e.g., occupancy, abundance data) to predict distributions at local to landscape scales. Here, we develop an integrated, hierarchical Bayes model that simultaneously uses both types of information to predict species distribution. We assess the potential of this model with spatially explicit, multi-scale simulations. We also illustrate the utility of the model with two empirical examples. First, we link coarse-scale citizen science (presence-only) data with fine-scale occupancy data to predict fox squirrel distribution in Florida. Second, we use Breeding Bird Survey data with fine-scale data on biofuels land-use management and bird diversity to predict biodiversity change under different biofuels scenarios for the Southeastern U.S. Simulations highlight that this modeling approach provides unbiased estimates of distribution, except in situations where occurrence data at the coarse-grain shows high levels of false absences. Based on cross-validation, this modeling approach provides better predictions for fox squirrel distribution than modeling scales separately. For the biofuels example, this modeling approach provides predictions for biofuels scenarios not obtainable with other common distribution modeling approaches. Integrated models provide flexibility of using a variety of datasets to model landscape patterns, and allow for seamless accounting of uncertainty in model predictions.

Drivers of local policy response to urban sprawl: Evidence from Switzerland

Sophie C. Rudolf, Swiss Federal Institute for Forest, Snow and Landscape Research WSL; Anna M. Hersperger, Swiss Federal Institute for Forest, Snow and Landscape Research WSL*

Urban sprawl represents a major challenge for Swiss spatial planning, as in many other regions of the world. Starting in the middle of the 20th century, local planning authorities have developed and enacted a wide range of policy instruments in order to curb this phenomenon. However, amount and type of policy instruments vary greatly among municipalities and their prevalence has never been exhaustively inventoried. In order to bridge this knowledge gap, we addressed a questionnaire to Swiss municipalities and recorded the implementation frequency of more than 20 policy instruments aimed at steering urban development. Based on this unique dataset, we used multivariate statistics to create an index

measuring the local policy mixes implemented to control urban sprawl. In a second step, we plan to use econometric analyses to identify which local characteristics (e.g. population size, previous population growth) significantly influence the implementation of these policy mixes. This information is crucial in order to better understand the implementation of sprawl-reducing policy instruments and encourage local governments to engage in such policies.

Characterizing recent patterns of land conservation as part of a regional land-use regime.

Spencer R. Meyer, Yale University; Jonathan R. Thompson, Harvard Forest; Luca Morreale, Harvard Forest; and Brian Hall, Harvard Forest*

Land protection continues to be an important conservation strategy to mitigate biodiversity impacts associated with urbanization, climate change, and anthropogenic land use changes. Nearly 21% of the New England region of the U.S. is protected from development through a variety of mechanisms including public and private ownership and both fee-owned land and conservation easements. Because specific land protection regimes vary widely throughout the region, a thorough understanding, both spatially and temporally, of the factors driving land protection is vital for developing future landscape-scale conservation strategies. In order to inform a region-wide future land use planning process, we sought to: (1) classify how the modern land conservation regime varies across New England; and (2) identify the factors driving land protection since 1980. We performed k-means cluster analysis on biophysical, socio-economic, and land-use data to classify the region's conservation regimes. We then correlated each class to a series of underlying driving factors, including land value, development pressure, land use, ownership type, conservation value, and organizational capacity. Our results will: (1) make possible the modeling of future conservation scenarios; (2) identify gaps in the region's conservation portfolio; and (3) provide conservation and land use policy-makers and practitioners with spatially explicit guidance on viable and tractable conservation strategies.

Applying HANPP for sustainability asessment of agro-bioenergy ecosystem services

Oludunsin Arodudu,Leibniz-Centre for Agricultural Landscape Research (ZALF), Muncheberg, Germany & Potsdam University, Institute of Earth and Environmental Sciences, Potsdam-Golm, Germany; Katharina Helming, Leibniz-Centre for Agricultural Landscape Rese*

Agro-bioenergy ecosystem services (energy provisioning, carbon emission reduction and sequestration etc.) have been growing in prominence since the beginning of the climate change era. However, methodologies capable of capturing the supply and demand sides of the flow of agro-bioenergy ecosystem services; conceptual mindframes/paradigms for enhancing the understanding of the biophysical and socio-economic interactions and dynamics of this fast evolving coupled natural and human system (agro-bioenergy landscapes), as well as frameworks for addressing the variety of environmental and socio-economic impacts associated with this nature-society interrelationship over specific distances, within certain time frames and amongst different decision/policy makers (stakeholder) groups are still lacking. This study therefore explored the possibility of adapting an LCA-MFA (life cycle assessment-material flow accounting) concept called the HANPP (Human appropriation of net primary production) framework, and an hybrid of the HANPP framework with other LCA frameworks e.g. energy return on energy invested-EROI framework, greenhouse gas inventory/balance framework etc., for accounting adequately for both ends or sides of the agro-bioenergy ecosystem services flows; and telecoupling the biophysical and socio-economic interactions and impacts associated with agro-bioenergy ecosystem services, within specific distances/time horizons, across generic agro-climatic zones (tropics/sub-tropics/temperate), and amongst different stakeholder groups. Also, introducing the analysis of possible future sustainability trade-offs between emerging demand for agro-

bioenergy ecosystem services and future biodiversity/nature conservation needs/concerns made the application of HANPP together with other LCA frameworks much more robust, contemporary and forward-looking in the light of growing sustainability challenges such as food security, energy security, climate change mitigation, biodiversity/nature conservation concerns etc.

Hybrid Poplar Site Suitability and Water Resource Impact Modeling in Michigan

Scott Hillard, Robert Froese -Michigan Technological University, School of Forest Resources and Environmental Science*

Hybrid poplar is a promising feedstock for the current and emerging biomass and biomaterials industry. To avoid land competition with food crops, hybrid poplar should be deployed on marginal or retired agricultural lands within its range. Identifying optimal plantation sites, as well as predicting impacts on soil, air, and water resources is crucial for improving the outlook for hybrid poplar deployment and developing a supply system to ensure adequate feedstock supplies to industry. The state of Michigan presents an excellent opportunity to study potential hybrid poplar deployment and resource impacts, because of a diverse portfolio of landscapes and current land-use, as well as state interest in renewable energy. We wanted to know if hybrid poplar deployment in four land conversion scenarios would significantly alter watershed discharge as well as the duration of the impact from land conversion. Using the Soil and Water Assessment Tool (SWAT) we simulated land-use change from low productivity or abandoned agriculture lands to hybrid poplar plantations in three Great Lakes watersheds across Michigan. Model results indicate that evapotranspiration was reduced in all watersheds; however, discharge from the watersheds was not significantly altered in the modeled land conversion scenarios. Model results indicate no significant impact to watershed discharge from land conversion to hybrid poplar plantations. Michigan, due to its abundant water resources and low land rents, may be a suitable candidate for large-scale investment in a woody biomass to biofuel production industry.

Myzus persicae aphid epidemic expansion risk within crop field's landscapes: a cell model to describe pliant factors at patch scale.

Maria A. Martinez-Ghersa, IFEVA / Facultad de Agronomia, Universidad de Buenos Aires / CONICET; Analia I. Menendez, IFEVA / Facultad de AgronomÃ-a, Universidad de Buenos Aires / CONICET; Sofia L. Fernandez, IFEVA / Facultad de Agronomia, Universidad de*

Once aphids arrive to a field through long distance dispersal there are backdrop and pliant factors that control the risk of aphid epidemic expansion on the field. We use information describing the phenotypic (crop cover plant developmental stage) and cryptic (soil quality, previous herbivory, and ozone air contamination) landscape within large crop fields and information obtained through microcosm experiments to describe aphid population growth within and migration between patches to develop a cell model with a weekly time step to map the risk for aphid expansion in crops cultivated with Brassicaceae crops. Our model simulations show that the risk of expansion is strongly determined by the pattern of distribution of the initial infestation, and by the field landscape characteristics: diversity and spatial arrangement of the patches. Patch quality in terms of history of exposure to herbivory or ozone, largely determined aphid population growth and patch aphid carrying capacity. Both parameters were four or five times larger in patches previously exposed to either episodic stress. However the field landscape homogeneity was the main driver of epidemic expansion

Network modularity reveals spatial structure and fragmentation of exploited marine metapopulations

Tania S. Pena-Baca Laura I. Gonzalez-Guzman, University of Texas at Austin James R. Watson, Stockholm Resilience Centre Timothy H. Keitt, University of Texas at Austin*

On land, human impacts have fragmented once continuous populations. In contrast, little is known about the spatial structure and possible fragmentation of marine populations, even though their exploitation is well documented. Here, we quantified larval connectivity of red abalone and red sea urchin in the Southern California Bight - species considered short- and long-distance dispersers, respectively and which are prone to Allee effects - and performed simulations of their metapopulations under different levels of exploitation. Subdivisions or network modules were identified to determine the spatial structure and possible fragmentation under exploitation. Results suggest that unlike the red sea urchin metapopulation, which did not show fragmentation, the red abalone metapopulation shows a modular spatial structure. Its distribution is split into northern, central and southern subregions, the Northern Channel Islands form another module that joins the northern subregion some years, and the Southern Channel Islands form different modules over time. After years of fishing red abalone, connection strength and modularity scores decrease, but the number of modules increases quickly indicating larval dispersal within subregions weakens. The southern subregion splits and collapses more rapidly than the northern subregion and the Northern Channel Islands. These simulation results match empirical observations of remaining red abalone populations in these areas after decades of fishing. We conclude that the current spatial structure of this metapopulation is likely the result of fragmentation driven by exploitation over time. In particular, extirpated subregions may be hard to recover due to complex patterns of larval dispersal.

Changing Pattern of Impervious Surface in Mountainous City During Rapid Urbanization Period (2000-2012): a Case Study of Liangjiang Districtï¼ŒChongqingï¼ŒChina

Wenjie Fan, Jingjing Peng, Zhifang Wang, Liangji Kong - Peking University*

The negative ecological impacts of increasing impervious surface have been discussed in many papers, but only a few efforts have focused on landscape level analysis in rapid urbanization process. Understanding changing pattern of impervious surface and its ecological impacts can reflect on the ecological consequence of economic development in China. In this study, Liangjiang District, Chongqing City was chosen as the study site. Due to its mountainous characteristics, one of the most severe ecological results of urbanization in Liangjiang is soil erosion and hydrological deterioration.
Using landscape pattern analysis, the changing pattern of impervious surfaces coverage (ISC) involved with urbanization process from 2000-2012 was extracted by subpixel spectral unmixing method from TM images. The results show that during the period of 2000-2006, the impervious surface in the study area grew rapidly. During the period of 2006-2012, the growth rate slowed down in the core accumulation area. The construction area has been gradually moving from the urban core to the suburbs. The landscape pattern of Liang Jiang New Area performs high connectivity effected by the multi-center group development mode of Chongqing. And the expansion of impervious surface in Liang Jiang New Area experienced the process from enclosure accumulation to point radiation, as to network integration. The relation between the changing pattern of ISC and the slope level distribution has also been analyzed. As a conclusion, the paper put forwards some approaches for controlling and reducing surface runoff on the level of urban space strategy and landscape planning.

Landscape genomics of a range-expanding damselfly along a latitudinal gradient

Rachael Dudaniec Lund University Lesley Lancaster University of Aberdeen Erik Svensson Lund University Bengt Hansson Lund University*

Landscape genomics enables us to uncover mechanistic processes of adaptation in species undergoing range expansion due to changing environments. Insects with specialised habitat requirements, limited

dispersal and high sensitivity to temperature and precipitation make excellent subjects for examining this process. We use genomic markers (SNPs) derived from RAD-sequencing data to examine genomic variation in populations of damselflies (Ischnura elegans) spanning a 6-degree latitudinal gradient up to the species' expanding northern range limit in Sweden. I. elegans occupies diverse aquatic environments, including freshwater lakes and ponds, to brackish estuaries and bays connected to the Baltic Sea, which may be located in forested, developed or agricultural areas. To examine for variation in local adaptive processes along the sampling gradient and up to the species' range edge, we tested for genotype X environment interactions in relation to temperature, precipitation, salinity and other landscape features. We present the results of isolation by resistance analysis in combination with patterns of local environmental adaptation. Our approach may be applied to other systems concerned with the role of local adaptive processes and gene flow for species persistence within changing landscapes.

Connecting Soundscape to Landscape: Which Acoustic Index Best Describes Landscape Configuration?

Susan Fuller, Queensland University of Technology; A. Axel, Marshall University; David Tucker, Queensland University of Technology; Stuart Gage, Michigan State University*

Soundscape assessment has been proposed as a remote environmental monitoring tool for measuring the influence of disturbance on biodiversity, but few studies have attempted to connect the soundscape with landscape configuration. The goal of our study was to undertake the first comparative analysis of a suite of published acoustic indices to examine whether they provide comparable results relative to varying levels of landscape fragmentation and ecological condition in nineteen forest sites in eastern Australia. Our comparison of six acoustic indices according to time of day revealed that two indices, the acoustic complexity and the bioacoustic index, presented a similar pattern that was linked to avian song intensity, but was not related to landscape and biodiversity attributes. The diversity indices, acoustic entropy and acoustic diversity, and the normalized difference soundscape index revealed high nighttime sound, as well as a dawn and dusk chorus. These indices appear to be sensitive to nocturnal biodiversity which is abundant at night in warm, subtropical environments. We argue that there is need to better understand temporal partitioning of the soundscape by specific taxonomic groups, and this should involve integrated research on amphibians, insects and birds during a 24 hour cycle. The three indices that best connected the soundscape with landscape characteristics, ecological condition and bird species richness were acoustic entropy, acoustic evenness and the normalized difference soundscape index. This study has demonstrated that remote soundscape assessment can be implemented as a rapid ecological condition monitoring tool in fragmented Australian forest landscapes. However, further investigation should be dedicated to refining and/or combining existing acoustic indices and also to determine if these indices are appropriate in other landscapes and for other survey purposes.

Farmer agribusiness cooperatives as corporate agents in landscape management in New Zealand

Simon Swaffield, Lincoln University, NZ; Wendy McWilliam, Lincoln University, NZ.*

Global integration of food supply chains and associated environmental effects of agricultural intensification are prompting a search for effective models of sustainable landscape management Limitations of conventional regulatory and neo-liberal market based approaches have stimulated emergence of new forms of hybrid environmental governance involving self-organisation, co-management and partnership. In New Zealand, many agri-food businesses are constituted as co-operatives, owned and controlled by farmers. The effect of this form of self-organisation on rural environmental governance and landscape outcomes is critically examined based on analysis of the dairy industry, the largest single NZ export sector. Dairy sector expansion has been linked to degradation of

lowland landscape, particularly water quality, and the sector has promoted voluntary landscape management practices since 2003. However data from a range of sources including key informant interviews suggests that some successes in promoting environmental programmes though agribusiness-farmer cooperatives are offset by significant shortfalls in science knowledge, farmer uptake, and implementation, and that cumulative landscape-ecological effects of intensification remain unresolved. Producer owned agribusiness cooperatives are an essential part of the pathway to sustainable landscape management but need complementary action from policy and regulatory agencies, where new co-governance models are also being developed.

Landscape effects on spillover of insect natural enemies between crop and non-crop habitats

Diego J. Inclan, DAFNAE-Entomology, University of Padova; Pierfilippo Cerretti, DAFNAE-Entomology, University of Padova; Lorenzo Marini, DAFNAE-Entomology, University of Padova*

The intensification and expansion of agricultural land are among the main drivers affecting natural enemy diversity. Here, we used the highly-diverse group of tachinid and syrphid flies as a model to evaluate how the interaction between crop and non-crop habitats affects the diversity of insect natural enemies. Specifically, we evaluated (1) the potential spillover of tachinids in landscapes characterized by different proportions of crop and non-crop habitats, and (2) the spillover of natural enemies from two contrasting field margins into their adjacent crop. Our results demonstrate that the community of natural enemies can be affected not only by the proportion of semi-natural habitats in the landscape, but also by the specific type of semi-natural habitats. Furthermore, our results show that the spillover of parasitoids was favored by the low contrast in habitat structure between the crop and non-crop habitats. Given that the spillover of parasitoids was favored by the low contrast between grass margins and maize fields, it appears that grass margins could facilitate higher spillover of species in landscapes with annual crops. In contrast, hedgerows may enhance higher spillover of species in landscapes dominated by woody perennial crops. Therefore, strategies to conserve semi-natural habitats in agricultural landscapes needs to take into account the type and contrast of both crop and non-crop habitats.

The effect of climate change on mammalian interactions

Sara Freitas, University of California Riverside; Helen Regan, University of California Riverside*

Climate change is currently altering the environment at global and local scales, forcing organisms to adapt, relocate, evolve, or reduce in abundance and distribution. Many types of interactions between organisms will be altered, both within and between species, due to changes in community compositions, range shifts, and fragmentation that impact where individuals can survive, and how closely together they live. The aim of this paper is to create a comprehensive literature review of existing studies on these changing interactions with a focus on mammals. We bring together information gathered from many types of ecosystems to look for patterns in behavioral changes and trophic cascade reactions due to the effects of climate change, in an attempt to determine the importance of interactions between mammals to the functioning of ecosystems. We found that the organisms most frequently studied in the literature were large arctic animals and rodents. There were five types of interactions that appeared in the literature with bottom-up and predation interactions being the most common. In some cases, numerous interactions conferred resistance to climate change, while other times the loss of a few key species caused the entire food chain to destabilize. In this review, we found that mammalian interactions are important to the functioning of ecosystems and changes in those interactions can affect the ecosystem as a whole. Ecological frameworks are complex and dynamic, and when the interactions

that link them together are changed in significant ways due to climate change, the stability of the ecosystem can be compromised.

Identifying land use drivers of stream fragmentation and prioritizing restoration across an Amazonian watershed

**Amy Pocewicz, The Nature Conservancy - Wyoming Chapter; Edenise Garcia, The Nature Conservancy - Amazon Conservation Program*

Changes in stream flow caused by barriers such as dams can impact water temperature and chemistry, physical habitat structure and ecosystem connectivity, all of which can adversely affect fish and other aquatic species. Thus stream fragmentation resulting from land use change and road construction is a freshwater conservation concern in many parts of the world, including the Amazon basin. We focused on one Amazonian watershed, Brazil's Curua-Una basin, and identified the prevalence of stream fragmentation by roads and landscape factors that explain why some road-stream intersections become barriers. Through remote sensing analysis, we identified impoundments associated with road-stream intersections and estimate that 10% of 13,800 intersections are sources of stream fragmentation. We evaluated which land use and terrain variables best explain the presence of impoundments, using Random Forest models, with preliminary findings pointing to high levels of deforestation, high road densities, small tributaries and erodible terrain. These correlates may be useful for extrapolating estimates of fragmentation to other basins and highlight factors relevant to prevention or restoration of fragmentation. Finally, we describe stream connectivity using a barrier analysis tool, and integrate connectivity and riparian forest condition metrics to highlight sub-watersheds that could benefit the most from stream restoration investments.

Increasing human injury risk by Asiatic black bear induced by the changes in bear habitat and human society in Northern Japan

Takashi Machimura, Osaka University; Naoya Fujimoto, Osaka University; Takanori Matsui, Osaka University*

Human-wildlife conflict is a kind of negative ecosystem services threatening the security of both human life and wildlife. Human injury accidents by Asiatic black bear (Ursus thibetanus) are recently increasing in Japan. The landscape and human society related factors raising human injury risk were analyzed using the accident records over 13 years and geographical information in Akita Prefecture in the Northern Japan. The human injury risk jumped up by the factor of three and the accidents happened also in residential areas under the bear mass intrusion which occurs every few years caused by the poor beech mast production in autumn. Geographical distribution of human injury risk was estimated by means of the maximum entropy method (Maxent) for the first time. The major factors of human injury were bear habitat and human population in the normal beech mast production years. In contrast, farmland abandonment ratio became the most determinant factor in the poor beech mast production years. The human injury risk by bears was predicted to increase in future because of the human depopulation and increasing abandoned farmland.

Spatial arrangement of populations within a forest affects genetic diversity of a violet in urban fragmented forests

Yuichi Toma, Mitsubishi Research Institute; Junichi Imanishi, Kyoto University; Masashi Yokogawa, Osaka Museum of Natural History; Hiroshi Hashimoto, Meijo University; Ayumi Imanishi, Kindai University; Yukihiro Morimoto, Kyoto Gakuen University; Yuki Ha*

Habitat fragmentation is likely to have deleterious genetic consequences for plant populations. Although the genetic effects of fragmentation in plants have been investigated in various landscapes, such studies are scarce in urban landscapes where forests tend to be fragmented and have a complex internal structure. As urbanization extends, the importance of urban forests increases, especially in areas that retain some biodiversity. To conserve these fragmented habitats, the problem of decreasing genetic diversity in small and isolated populations must also be considered. We investigated spatial factors that affected the genetic diversity of a herbaceous species in urban fragmented forests. We surveyed distribution of Viola species and collected 30-39 leaf samples of Viola grypoceras A. Gray var. grypoceras, a perennial herbaceous species with short-distance seed dispersal, from 12 fragmented and 12 suburban forests each at Kyoto City, Japan, and analyzed the genetic diversity of this species by developing six simple sequence repeat markers. There was no significant difference in allelic richness between the urban fragmented and suburban forests. However, statistical analysis revealed that the internal structure of forests and spatial arrangement of populations within forests affected the genetic diversity of this species in urban fragmented forests. Although V. grypoceras has traits that allow it to tolerate fragmentation, such as self-pollination and seed bank-formation ability, pure loss of habitat and reduced fragment size might have deleterious effects on this species, and these effects might become more apparent if fragmentation continues to proceed in the future.

Application of a Scalable Change Detection Tool to Assess Climate Change Vulnerability for Important Bird Areas in the Bering Sea

Melanie Smith, Audubon Alaska; Will Koeppen, Axiom Consulting; Katherine Kuletz, Aaron Poe, Heather Renner, Jeff Williams, US Fish & Wildlife Service; Ellen Tyler, Alaska Ocean Observing System; Tom Van Pelt, Transboundary Ecologic; Jeremy Littell, US Geo

Climate change is already affecting the Bering Sea and Aleutian Islands region in Alaska. Newly available downscaled marine climate models for this region offer the opportunity to assess projected changes in habitats important to marine birds. We developed an open-access tool to conduct batched, change detection analyses of large raster datasets representing a suite of physical climate variables and climate-derived biological variables for the marine habitat in the region. We compared projected conditions from a 30 year past time period with those from a 30 year future time period using three coupled, ocean-climate models. We focused these analyses on pelagic polygons that have been defined as globally significant Important Bird Areas. We developed indices of change for selected marine habitat variables to identify which IBAs might experience the greatest amount of total change in a future climate regime. We will share details of the methods for analyzing change and prioritizing areas, development of the change detection tool, and the potential for scalable future applications. The results of this assessment are useful for land managers in Alaska who will benefit from understanding which areas and species are predicted to be most vulnerable to climate change, and which are the highest priorities for action.

Mowing in agricultural activity maintains alternative habitat of an endangered grassland species Gentiana thunbergii (G. Don) Griseb.

Ayumi Imanishi, Kindai University; Junichi Imanishi, Kyoto University; Naoki Kawase, Minakuchi Kodomo-no-mori Nature Museum; Yosihiro Natuhara, Nagoya University*

Gentiana thunbergii (G. Don) Griseb. is a small winter annual plant that flowers in early spring. Because of habitat development and over collection for horticulture, this plant has become an endangered grassland species. Semi-natural grasslands established on small landscape components, such as levees of paddy fields and agricultural reservoirs, are important alternative habitats for this species in our study

area, southern mountainous area of Lake Biwa, Japan. The purpose of this study is to determine the optimal environmental conditions of the alternative habitats of this species in semi-natural grasslands maintained by agricultural practices. The mean soil volumetric water content of the study sites was 50.4%, while there was a significant moderate negative partial correlation between plant population density and soil water content. These findings indicate that although a moderately wet environment is necessary for species growth, excessive wetness is unsuitable. A significant moderate positive partial correlation between number of individuals and relative photosynthetically active radiation (PAR) was found, and relative PAR had a significant fairly strong negative correlation with the height of the surrounding plants. It is considered that the well-lighted environment, maintained by agricultural activities such as regular mowing management contributes to survival of the G. thunbergii population in the levees of paddy fields and the other landscape components in paddy-field areas.

Scale-dependence of biotic interactions: implications during climate change

Phoebe L. Zarnetske, Michigan State University; Jonathan Belmaker, Tel Aviv University; Sydne Record, Bryn Mawr College; Mao-Ning Tuanmu, Yale University; Angela Strecker, Portland State University; Lydia Beaudrot, Conservation International; Sara Zonnev*

Understanding the scales over which biotic interactions operate is critical for predicting species distributional changes in the face of the ongoing biodiversity crisis. It is thought that biotic interactions operate predominately at fine grains, yet this has received relatively little empirical scrutiny. Across grain and extent, we used logistic mixed effects models to assess the relative importance of biotic interactions for woodpeckers, as compared to environmental suitability, and geographic proximity to other intraspecific occurrence sites. We found that when a species experienced positive biotic interactions, the importance of biotic interactions decreased with increased grain. Yet positive interactions remained important at a grain size of 40km, which is much coarser than that used by most species distribution models. In a follow-up study we assessed how researchers treat scale when incorporating biotic interactions and dispersal into models predicting the effects of climate change on species distributions. Not surprisingly, we found that spatial grain and extent affects predictions. Specifically, broad extents and coarse grains increase the effect sizes between models that incorporate biological complexity, and those that do not. Based on our review, we offer a set of best practices for assessing the impacts of climate change with species distribution models: 1) Match spatial grain and extent to species' biology; 2) Conduct more studies in aquatic systems, on a wider range of species, and across the tropics, Asia, and the Southern Hemisphere; 3) Include analyses at multiple scales, with and without biotic interactions; and 4) Compare model outcomes with different climate change scenarios.

Responding to a changing world: Modeling adaptive management agents in forest landscapes

Werner Rammer, Institute of Silviculture, University of Natural Resources and Life Sciences, Vienna; Rupert Seidl, Institute of Silviculture, University of Natural Resources and Life Sciences, Vienna*

Today's forests face increasing environmental pressures such as changes in the climate and disturbance regimes, and are at the same time expected to satisfy society's increasing demand for ecosystem services. In response to these drivers (both social and ecological), ecosystems as well as managers are adapting. A realistic modeling of managed forest landscapes thus needs to explicitly incorporate the dynamic interactions between social and ecological systems (SES). Here, we present a novel framework for an integrated modeling of SES, combining a process-based forest landscape model with a newly developed agent-based model of forest management. Forest managers are simulated as adaptive agents acting autonomously on the parts of the landscape under their stewardship. An agent's response to changes in the ecosystem is parameterized using data from empirical surveys among forest

practitioners. Potential adaptive actions of managers, such as altering tree species composition or the thinning regime, are subsequently implemented in the individual-tree based ecosystem model environment, in turn affecting ecosystem trajectories. This dynamic coupling of a high resolution landscape model with an agent-based model of forest management allows the integrated simulation of SES, furthering the quantification of adaptive capacity and the identification of robust pathways in forest management.

Integrated swidden-oil palm landscapes. Unexpected outcomes of regime shifts in Southeast Asia land use systems

Ole Mertz, Geography, University of Copenhagen

Swidden cultivation is rapidly being transformed in Southeast Asia and is accompanied by considerable change in livelihoods and landscapes. In many places, this transformation is driven by investments in plantations that in some cases are large-scale company operations, but in others are run by smallholders on their own land, often benefitting from the infrastructure of plantation companies. In Sarawak, Malaysia, for example, many smallholders increasingly plant their own oil palm as a reaction to what they consider unfair deals with plantation companies. In doing so, they maintain elements of their diverse smallholder farming systems by intercropping oil palm with upland rice during the first years of the plantation and mixing with other shade-tolerant crops and fruit trees in later stages. Thus, oil palm appears to be treated as a productive 'fallow', in the sense that after peak production, the oil palm and other vegetation will be cleared and upland rice planted again. Such integration of perennial cash crops and upland rice production has been used by smallholders for more than a century in Borneo and elsewhere, and it now appears that oil palm - often considered more controversial and environmental damaging - may just be a new crop in a traditional system. This creates landscapes that differ from the large monocultural oil palm plantations by having both annual fields and forest patches in the plantation areas and thus a somewhat unexpected outcome of the forest-to-plantation regime shift.

Integrated Landscape Conservation of Traditional Agricultural Regions in Urban Agglomeration: Case Study of Uji Tea Growing Region

Monte Cassim, College of Policy Science, Ritsumeikan University; Takahiro Ota, Faculty of Environmental Studies, Nagasaki University; Xuepeng Qian, College of Asia Pacific Studies, Ritsumeikan Asia Pacific University*

The landscape conservation is always a big concern in the development of urban agglomeration, especially when cultural issues are involved. Uji, located at Keihanshin Metropolitan area, is the place where Japanese tea culture originated over 800 years ago. Uji has ideal climatic conditions and water resources which are essential for the cultivation of good tea. Through the landscape conservation project of Uji tea growing region, this study aims to create the knowledge commons for sharing the landscape conservation information obtained as follows. First, we collected and analyzed the fundamental factors for landscape conservation by using ICT, such as one original application software in mobile devices for plant information recording. We worked on the catalogue of teas and other plants that form the landscape and the database of environmental factors that influence the landscape in Uji. Second, we designed the knowledge creation and inheritance system in partnership with local communities and conducted education and training programs supported by junior and high schools in order to raise the citizens' awareness. It proved the effectiveness of transdisciplinary collaboration and community participation in urban development and provided a method that helped to improve the efficiency of such communications by utilizing digital devices and cloud service. Furthermore, we integrated landscape conservation measures in the project and proposed it as a systematic solution

named 'Human-Expert Cloud service (HECS) '. It is also expected to promote the sustainability of the traditional agriculture in the progress of urban agglomeration.

Niche Modeling of Three Swallow Species Using Civic Survey Data: Availability of Smartphone-assisted Survey System

Mahito Kamada, Institute of Technology and Science, Tokushima Universtity, Japan

Knowing species distribution is an essential for establishing a plan of ecosystem conservation, and scientist and/or governmental officer frequently propose collaborative survey participated by civic people. Difficulty in the collaborative survey is how to keep accuracy, in terms of species identification and localities, which is claimed by scientists. Smartphone equipped with GPS can be used for obtaining photo of target species as well as the location. Those data can be easily sent to server. Once the data are stocked in the server, they can be shown on Google Map immediately and easily shared with everyone. From the photos, specialist can confirm and raise accuracy of species identification by civic people. Using the smartphone-assisted system, NPOs conducted a survey for finding nests of three swallow species, barn swallow (Hirundo rustica), red-rumped swallow (H. daurica) and house martin (Delichon urbica), for entire area of Tokushima Pref. in August of 2013, and 458 distribution data were reported in a month. After confirmation of species identification and location, spatial models that explained difference of niche of the species could be developed by adopting Maximum Entropy Modeling. Conclusively say, the smartphone-assisted survey system has great availability to bridge interests between civic people and scientists and to encourage civic science.

Utilizing Patch Metrics to Improve Classification of Remote Sensing Imagery

Michael L. Treglia, Department of Biological Science, The University of Tulsa, Oklahoma NSF-EPSCoR Program; Megan E. Young, Department of Wildlife and Fisheries Sciences, Texas A&M University*

Classified remote sensing imagery is invaluable for monitoring and management of landscapes through time. However, similar spectral signatures for different types land cover poses difficulties in achieving accurate classification results. For example, individual pixels of sand dunes and caliche roads, or forests and forested riparian areas, may appear similar when not taking the arrangement of pixels into account. Some object-oriented techniques have been developed to deal with this issue, in which clumps of similar pixels are identified, and classified as individual units. However, it can be difficult to encompass adequate variability of spectral signatures and shapes for distinct land cover types. Some software packages have been developed to deal with such issues, but they are typically expensive for smaller organizations and single users. We suggest patch metrics, commonly employed in landscape ecology for describing landscape pattern, and calculated using the free software, Fragstats, may be employed in a multi-step image classification process, to improve results at no additional cost. We present tests of this classification process for complex landscapes in western Texas, southern California, and eastern Oklahoma, USA.

Assessing scale mismatches for landscape restoration planning using social-ecological network analysis

Jesse S. Sayles, School of Geographical Sciences and Urban Planning, Arizona State University*

Landscape restoration has become a global priority as evidenced by the United Nations' 2020 goal to restore 150 million ha of land worldwide. Estuary watersheds, which provide essential ecosystem services, are in particular need of restoration due to the considerable pressure humans exert on coastal systems. Estuary restoration requires understanding both bio-physical and socio-political landscapes

because actions throughout the watershed affect one another and ecosystem recovery must be coordinated among various socio-political units. Such scale mismatch, or incongruence between governance and bio-physical boundaries, is a fundamental challenge that can undermine restoration success. Unfortunately, scale mismatches have rarely been analyzed in a spatially explicit way and have yet to be integrated into restoration planning. In this paper, I present a novel social-ecological framework based on network science that I applied to salmon restoration in Puget Sound, Washington, U.S.A. I relate this spatially explicit network structure to social-ecological processes using interviews with restoration practitioners, and discuss how municipal, tribal, and other borders may affect restoration. I also discuss challenges and best practices for conducting social-ecological network analysis and mapping. Using indicators such as network density, interaction frequency and collaboration productivity, I found areas where networks are likely unable to overcome scale mismatch. Overlaying network productivity with ecological restoration needs shows social-ecological restoration hotspots (social and ecological concerns) and low hanging fruit (ecological concerns only). Cross-boundary collaboration challenges stem from both top-down and bottom-up socio-political processes. This analysis is a fundamental step towards social-ecological approaches to landscape restoration and can aid regional planning.

The longleaf pine ecosystem: ecology and restoration of the FIRE FOREST

L. Katherine Kirkman J. W. Jones Ecological Research Center

Restoration of the fire-dependent, species-rich longleaf pine (Pinus palustris-Aristida beyrichiana) ecosystem of the southeastern United States is a daunting task and requires knowledge of the complex relationships between stand structure, fuels, longleaf pine regeneration and mechanisms that maintain diversity. Several studies illustrate approaches to merging basic and applied research related to ecological restoration of the diverse native ground cover. A long-term, resource-manipulation and fire-exclusion study was conducted to examine relationships between productivity, disturbance, and species richness. It was coupled with complementary short-term studies to determine the relative importance of recruitment limitations on seedling diversity. These studies were the first to suggest that the disturbance due to prescribed fire has a greater role in structuring biodiversity than does productivity, and that the episodic supply of microsites for recruitment could influence species richness in the highly threatened and biodiverse longleaf pine savanna. Other case studies from silvicultural restoration and applied conservation management in second-growth stands provide insights for developing conservation models for longleaf pine ecosystems and have been used to identify important conservation and forest management principles that challenge prevailing forest management and restoration paradigms.

Moderated Discussion

Kim Selkoe, NCEAS & U. Hawaii; Oscar Gaggiotti, U. St. Andrews; Rob Toonen, U. Hawaii*

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Improving open spaces for a sustainable city

Karin Schwabe Meneguetti, Universidade Estadual de Maringa*

The viability of city living in communion with the natural landscape as a way to restore the balance between human uses and natural processes is the focus of this poster about the city of Maringa, Brazil. The urban form of Maringa, a newly-planned town founded in 1947 upon a previous, comprehensive British land-development scheme, originally provided for a friendly interaction between the urban

settlement and the natural landscape. Basically, local natural features were regarded as a major focus during town planning. Thus, the organic, garden-city-like layout was the result of adapting the built environment to the site. Two subsequent master plans, imposing stream-preservation corridors, established the fundamental connectivity for, and the sustainability of, the green patches seen in the original layout. Despite its massive, fast, and barely controlled urban development, Maringa still preserves those initial potentialities. Hence, this poster will outline how open spaces could be enhanced as a green infrastructure by bringing parks, squares, gardens and urban farming into a productive system both for nature's and people's sakes. The adoption of this kind of ecological planning would certainly result in an increase in urban landscape quality, changing the current planning paradigm and preventing the city from environmental quality decline.

Analysis of neighborhood-level genetic diversity and simulation modeling suggest road impacts on a small mammal

Karl Jarvis, School of Forestry, Northern Arizona University; Sam Cushman, Rocky Mountain Research Station, US Forest Service; Brett Dickson, Conservation Science Partners and Northern Arizona University; Paul Beier, School of Forestry, Northern Arizona*

In the field of molecular road ecology, most studies investigate genetic divergence. We added to this approach by studying the effects of highways on neighborhoods of genetic diversity surrounding individuals and by simulating a range of avoidance and mortality scenarios. We tested hypotheses about the effect that mortality and physical barriers have on spatial patterns of genetic diversity in the desert kangaroo rat Dipodomys deserti. Our work provides inferences regarding the differential effects of avoidance and mortality on spatial genetic diversity and how human infrastructure impacts a fundamentally important member of Sonoran desert ecosystems.

Mapping Cultural Ecosystem Services Potentials in Germany

Johannes Hermes, Institute for Environmental Planning, Leibniz Universitat Hannover; Christian Albert, Institute for Environmental Planning, Leibniz Universitat Hannover and Department of Environmental Politics, Helmholtz Centre for Environmental Researc*

Action 5 of the European Union's Biodiversity Strategy calls upon its Member States to map and assess the state of the ecosystems and their services by 2014. Responding to this call is challenging due to limited data availability and a current lack of methods which can appropriately cover the national scale, in particular for Cultural Ecosystem Services (CES) such as recreation, inspiration and aesthetics. The objective of the presented research project is (1) to develop appropriate methods for a nationwide assessment and economic valuation of CES for after work and weekend recreation, (2) to apply these methods, contingent upon the availability of appropriate data, and (3) to point out gaps in knowledge and data availability. This presentation will introduce a new multi criteria analysis approach for assessing and mapping CES on the national scale, focusing explicitly on CES for after work and weekend recreation. First results of the application of the developed method will be presented. Also the methodology and first results of a representative empirical study on preferences and economic values, that supplements the spatial analysis, will be presented. The usability of the results for decision support on national scale, but also on federal and regional scale will be discussed. Furthermore, the need for action in the fields of data and methodological development will be identified. Finally, conclusions are drawn concerning potential improvement options, next research steps and lessons-learned.

he Effects of Urban Forms on Photosynthetically Active Radiation and Performance of Urban Greenery in a Compact City

Tan Puay Yok, National University of Singapore; Mirza Rifqi bin Ismail, National University of Singapore*

Urban green spaces (UGS) are recognized to provide a multitude of ecosystem services. Yet the highly built-up milieu of the urban environment also imposes considerable challenges on the amount and performance of UGS due to space constraints and sub-optimal biophysical conditions that limit plant growth. As ecosystem services of UGS are underpinned by biological and biophysical processes such as photosynthesis, transpiration and biomass accumulation, we argue that efforts to increase the benefits UGS should also focus on understanding and alleviating unfavorable growth factors, over and above efforts to increase amount of UGS. One possible limitation of the urban environment on the performance of urban greenery is the level of photosynthetically active radiation (PAR) in the urban environment that is available to drive growth processes in plants. This is an area that has yet to receive adequate attention despite the ubiquity of shade in urban areas. PAR is a critical input for plant growth as photosynthetic energy provides plants with almost all of their chemical energy needs, and hence is central to their ability to survive, grow and reproduce. PAR therefore is a key factor that determines the level of ecosystem services provided by UGS. Reduced levels of PAR in shaded UGS and how this limits urban ecosystem services is a current knowledge gap. This presentation provides an overview of studies to understand how different urban forms limit PAR and how this in turn, affects the performance of UGS in the compact city of Singapore

Using IBMs to investigate spatially-dependent processes in landscape genetics theory

Nathan H. Schumaker, US Environmental Protection Agency; Jennifer MW. Day, University of Washington; Allen Brookes, US Environmental Protection Agency*

Much of landscape and conservation genetics theory has been derived using non-spatial mathematical models. Here, we use a mechanistic, spatially-explicit, eco-evolutionary IBM to examine the utility of this theoretical framework in landscapes with spatial structure. Our analysis explores the following fundamental questions: 1) In well-connected landscapes exhibiting little genetic drift, how does isolation by distance (IBD) affect inferences of genetic structure? 2) In disconnected landscapes, how does drift interact with IBD, and thus affect inferences of genetic structure? 3) In poorly-connected landscapes, how effective is dispersal at homogenizing population structures resulting from both IBD and drift? 4) In poorly-connected landscapes, how does dispersal ability influence genetic structure when populations are subjected to IBD, drift, and selective pressure? We use our study to examine the potential that eco-evolutionary IBMs have for contributing to landscape and conservation genetics theory.

Integrated urban land use planning based on improving ecosystem service: Panyu case, in a typical developed area of China

Deyong Yu State Key Laboratory of Earth Surface Processes and Resource Ecology/Human-Environment System Sustainability (CHESS), Beijing Normal University, Beijing 100875, China*

The world is undergoing rapid urbanization and fast population growth in urban areas. In 2008, the world urban population (approximately 3.3 billion) has reached over 50% of total population and the percentage in 2050 is estimated to be over 2/3 of the world population. From the ecological viewpoint, urbanization inevitably causes changes in types of land use, thus influencing the ecosystem, mainly in the form of structures, compositions and ecosystem services. In urban areas, the requirements of social, economic and ecological sustainable development are usually intertwined with the problems of land use intransigence, fragmentation and deterioration of quality of natural systems. This study aims to the application of ecological principles to develop an integrated urban land use planning for Panyu case that could optimize the urban ecosystem. Panyu is classified into four functional zones: (1) ecological

protection areas, which are important to maintain regional ecological process, (2) restricted construction areas, which can be changed and adjusted over time without losing the conservation potential, (3) suitable construction areas, which are set aside for future development, and (4) built-up areas. Different land use management measures with emphases either on ecological aims or construction are proposed. Ecological patches are connected by corridors to form an ecological network which is spatially flexible and has the potential to integrate development and conservation and make conservation of species diversity adaptive. We predict that ecosystem service will increase by 16.91% after our planning implementation.

Drivers of agricultural expansion in Argentina

M. Piquer-Rodriguez, Humboldt Universitat zu Berlin; V. Butsic, University of California, Berkeley; G. Gavier-Pizarro, National Institute of Agricultural Technology (INTA) - Buenos Aires; J. Volante, National Institute of Agricultural Technology (INTA) -

Land-use changes are driven by global factors (such as international markets and prices) and local determinants (such as biophysical conditions or land ownership). In Argentina there have been large increases in agricultural production in the Pampas and Chaco regions over the last decade. Grasslands and dry forests have been converted at a rapid pace, causing among the highest deforestation rates in the world. Understanding the relative importance of global, regional and local drivers of change is essential to identifying policy levers in land-system dynamics to lessen the drastic environmental trade-offs of agricultural expansion. We developed a net returns econometric model of land-use change for the Pampas and the Chaco regions of Argentina from 2000-2010 to understand land-system dynamics from an economic perspective. We studied three main land-use conversions: 1) from forest to intensified croplands, 2) from forest into grazing and 3) from grazing to intensive croplands. Using the model results, we simulated area conversions under different crop revenue scenarios. For the studied period, about 70% of forest loss was due to conversion from forest to cropland, while 30% was due to conversions to grazing. Revenues from crops were typically more than double the revenue for grazing or forest preservation. Likewise, crop revenues increased quickly due to a combination of increases in both crop yields and global agricultural commodities' prices. Our research suggests that global-scale economic drivers can have profound impacts on regional land-use dynamics, but that these drivers can play out surprisingly different in different regions.

Urban Transition and Resilient Urban Development: Climate impacts and spatio-temporal assessment of urban vulnerability

Shu-Li Huang, Graduate Institute of Urban Planning, National Taipei University, Taiwan; Ying-Chieh Lee, Lee-Ming Institute of Technology, Taiwan; Li-Fang Chang, Graduate Insitute of Urban Planning, National Taipei University, Taiwan*

Global environmental change has prompted concerns over the role of urban areas in global systems. Urbanization, both as a social phenomenon and a physical transformation of landscapes, is a powerful, often irreversible and highly visible anthropogenic force worldwide. Currently, there are more than 50% of population resides in urban areas which generate more than 90% of global economy, consume more than 65% of the world's energy and emit 70 % of global greenhouse gas emission. However, the urban and economic growth cannot mitigate the climate impacts due to the insufficient adaptive capacity and resulted in the challenge to urban resilience and vulnerability. This paper raised the issue that the resilience and vulnerability of a city in response to climate impacts are characterized with dynamic change and spatial variation. The spatio-temporal effects of urban resilience and vulnerability are subject to the urban growth, spatial plans, and development of infrastructure during the periods of

urban transition. In addition, the characteristics of urban form (e.g. density, intensity, accessibility, mixed land use, compact or sprawl, etc.) as effected by urban transition is an important means to cope with climate change as well. Using Taipei as a case study, this paper addresses: (1) How urban development affect vulnerability to climate change? (2) How different urban forms affect vulnerability to climate change? and (3) How urban spatial planning affect vulnerability to climate change?

Characterizing spatial patterns of air pollution on multiple time scales in China

Yupeng Liu, Beijing Normal University; Jianguo Wu, Arizona State University; Deyong Yu, Beijing Normal University*

China's tremendous economic achievements in the past three decades have resulted in deterioration of air quality. Monitoring the spatial patterns of air pollution over time helps understanding its transport mechanisms and assessing its impacts on human health. In this study, we quantified the spatial patterns and movement of air pollution at annual, daily, and hourly scales. From 1999 to 2011, a total area of approximately 2 to 2.7 million km2 in China failed to meet the annual standard of PM2.5 concentration (35 Î¼g/m3) set by the World Health Organization and Chinese air quality standard. About 700-1000 million people (52%-72% of China's total population) lived in the air polluted region which included the eastern China and the southern part of Xinjiang Province. We also conducted a detailed daily- and hourly-scale analysis of the emergence, development, and dissipation of a typical air pollution event which occurred in the North China Plain during October 6 and 12, 2014. Our results indicated that the geometric center of air pollution region emerged at the junction of Hebei, Henan, and Shandong provinces on Oct. 6, moved northward and sustained in Hebei Province and Beijing between Oct. 7 and 11, and then moved southward and dissipated in Shandong Province on Oct. 12. Largest patch index (LPI) and Aggregation index (AI) maximized at Oct. 9 when air pollution areas spatially clumped into a single and compact region. Our study demonstrates that a landscape ecological approach is important and effective in monitoring and assessing regional air pollution.

Encroachment of woody vegetation drives rapid state change in insular grasslands

Jesse Miller, University of Wisconsin; Ellen Damschen, University of Wisconsin

Rapid ecosystem state changes, such as transitions from grasslands to woodlands, can have significant consequences for biodiversity and ecosystem function. Factors causing such state changes and appropriate management strategies for maintaining stability, however, remain poorly understood. In this study, we used historic aerial photos to analyze rates of woody encroachment into Ozark glades (fire-adapted grasslands) and potential drivers of these state changes. We hypothesized that local environmental variables, landscape context, and prior woody cover would all affect state changes. We compared long-term change in glades managed with prescribed fire and mechanical thinning with unmanaged glades. We found that woody vegetation has increased significantly across the landscape since 1939, with only minor sensitivity to local environmental factors and landscape context. Previous cover of woody vegetation was, however, a strong predictor of encroachment rates, suggesting that propagule arrival has a stronger influence on encroachment than environmental filters. Woody vegetation cover was higher in unmanaged glades than managed glades, but contemporary managed glades still have significantly higher woody vegetation cover than they did in 1939. Our findings suggest that woody encroachment in glades exhibits hysteresis, meaning that restoring encroached glade landscapes will likely require more intensive management efforts than maintaining existing open glades.

Effects of amount of semi-natural habitats and crop mosaic heterogeneity on generalist predators communities (Araenae and Carabidae) and biological control potential

*Colette Bertrand *, INRA SAD-Paysage Rennes France ; Romain Georges, CNRS Ecobio Rennes France ; Francoise Burel, CNRS Ecobio Rennes France ; Jacques Baudry, INRA SAD-Paysage Rennes France*

Carabid beetles and spiders are important generalist predators which may generate an effective control of pest populations. However, to maintain or promote them, it is necessary to better understand the factors that may influence predator communities and predation rates. Previous work has demonstrated that agricultural landscapes which contain significant areas of semi-natural habitats support higher biodiversity and better ecosystem services. But little is known on the effects of the heterogeneity of the cropped area itself. In this study, we investigated the relative and interactive effects of crop heterogeneity (crop composition and configuration) and amount of semi-natural habitats. Within the European FarmLand project (www.farmland-biodiversity.org), we worked in six agricultural regions spanning across western Europe, and differing in terms of landscape complexity : Gottingen (Germany), Armorique, Plaine et Val de SÃ¨vre, Coteaux de Gascogne and Camargue (France), and Lleida (Catalonia, Spain). In each region, carabids and spiders were sampled using pitfall traps along independent gradients in crop composition (crop diversity) and crop configuration (crop mean size), and biological control potential was estimated by recording the removal rate of experimentally added aphids. Agricultural landscapes with more heterogeneous croplands have higher biodiversity and biological control potential, but these effects are modulated by the regional context, and in particular on the amount of semi-natural habitats.

Applying behavioral movement analyses for modeling landscape resistance and connectivity in conservation planning

Hendrik Edelhoff, Georg-August University Goettingen; Niko Balkenhol, Georg-August University Goettingen*

Assessing landscape resistance towards movements and dispersal of organisms is an essential part of connectivity modeling and planning. Movement analyses, for example using telemetry data, are increasingly applied to model resource selection or the response of animals towards different landscape structures. Furthermore, with increasing movement data available at high temporal resolution (e.g. GPS telemetry), new insights about the behavioral states of the observed organisms are possible. Surprisingly few studies currently consider behavioral changes and stage-dependent habitat preferences when modeling connectivity, for example to distinguish habitat influences on every-day movements from influences during dispersal or migratory phases. While behavioral movement analysis has great potential for improving our understanding of landscape effects on animal movement and connectivity, it is currently challenging to apply in practice due to the large number of different methods available for path segmentation. Here, we present an overview of recently proposed methods for objectively distinguishing different behaviors within movement paths. These methods fall into three types of approaches and have different advantages and limitations, which we compare and illustrate using GPS telemetry data of 23 Red Deer (Cervus elaphus) from Northern Germany. Specifically, we applied different path segmentation methods to determine dispersal paths, assess dispersal-specific habitat preferences, and develop landscape resistance models from these data. Our results suggest that resistance and connectivity models depend on the methods used to identify path segments, and that available telemetry data have to be carefully matched to the appropriate path segmentation methods for accurate inferences.

Shifting sediment runoff regimes in a New Zealand watershed resulting from land use and climate changes

Jason P. Julian, Texas State University; Ioannis Kamarinas, Texas State University; Kirsten de Beurs, Oklahoma University; Braden Owsley, Texas State University; Andrew Hughes, NIWA*

Watershed-scale interactions between land management and climate can have profound impacts on sediment runoff and thus river water quality. While land use effects on water quality are generally thought of as linear relationships; here we show that the sediment runoff regime in a subtropical watershed in New Zealand displays shifting, nonlinear patterns. Detecting these regime shifts required high resolution land cover data, both spatially (30 m) and temporally (weekly). Disturbed pixels (bare soil) for both forests and grasslands in the 268-km2 Hoteo River watershed were identified using fused Landsat and MODIS satellite imagery. We found the land surface to be dynamic, responding quickly to storms, drought, forest clearings, and grazing practices. This high-resolution land disturbance time-series was then compared to daily rainfall, daily runoff, and monthly water samples to assess the effects of changing weather and land cover on water turbidity. Forest clearings created the most intense land disturbances. Pasture areas during four extended droughts were also characterized by high disturbance. Water turbidity patterns generally followed these shifting disturbance patterns. The relationships we found suggest that intense land disturbances have the ability to switch the watershed from supply-limited (sediment runoff is dictated by what is available from the landscape) to transport-limited (loadings from the landscape are abundant, and thus dictated by water runoff). This research demonstrates (1) the vulnerability of intense agricultural landscapes to drought; and (2) better understanding of the complexity of sediment runoff regimes when high-resolution land cover and water quality data are available.

Emerging trends and research priorities in landscape planning: some hypotheses

Christian Albert, Leibniz Universitat Hannover & Helmholtz Centre for Environmental Research - UFZ; Vivek Shandas, Portland State University; Wei-Ning Xiang, University of North Carolina at Charlotte & East China Normal University*

This contribution will introduce the background, objectives, proposed schedule and the envisioned outcomes of the symposium "Innovations in Landscape Planning: Exploring Novel Approaches and Future Directions". Furthermore, based on a literature review and a survey among symposium participants elicited before the beginning of the conference, we will put forward some hypotheses for trends and research priorities in landscape planning. The propositions shall provide the background and inspire the discussions within the symposium and will be further elaborated in a joint writing process following the conference.

The Forest Landscape Model LandClim: State of Affairs, Success Stories and Challenges

Harald Bugmann, Forest Ecology ETH Zurich; Laura Schuler, Forest Ecology ETH Zurich; Timothy Thrippleton, Forest Ecology ETH Zurich; Rebecca Snell, Forest Ecology ETH Zurich, Forest Ecology ETH Zurich*

Over the past 10+ years, we have been developing the Forest Landscape Model LandClim, which tries to balance process resolution at the pixel and landscape scale with ease of parameterization and application. For example, while tree individuals are simulated at the pixel scale, we refrain from a 'mechanistic' modeling of photosynthesis and respiration. Model behavior has been tested against various data sources in different parts of the world, including long-term data across the Holocene. These studies show that the model is a useful tool to provide a better understanding of vegetation properties and dynamics, although major uncertainties remain. Recent changes to the model structure include (1) the explicit modeling of bark beetle dynamics, again making compromises between the level of detail to

include and the tractability of the problem; (2) the representation of understory vegetation, which is based on a plant functional type approach and trying to avoid a fully spatially explicit approach; (3) non-forest vegetation cover (grasslands) including their management, so as to make a major step towards a true "landscape" (rather than "forest") model. I will review the state of the model, show examples of model application, and will discuss major challenges that remain in the context of assessing the impacts of climate change on landscape dynamics.

Diversity and geographic distribution pattern of shrub species in Xinjiang, China

Zhou Huarong, Liang Xueqiong Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences

Using list of flora and geographical information, coupled with GIS and statistical methods, the study was to investigate spatial patterns of shrub species diversity in Xinjiang, China, and its relationship with geographical factors. Presently, there are 416 species (including 20 varieties) of shrubs belonging to 35 families and 109 genera in Xinjiang. Shrubs are confined to the northern part of Xinjiang at families, genera and species levels, and Altay prefecture, Yili prefecture and Urumqi are three centers of shrub diversity in Xinjiang. Species richness decreases across Xinjiang from east to west, and has a relationship with other geographical factors. From south to north, shrub species richness increases due to precipitation in Northern Xinjiang being significantly higher than in the south of the province. This results in an increase in shrub diversity with increasing latitude which needs further analysis combining with climate data. Through correlation analysis, species richness was negatively correlated with area. This is due to larger counties containing a large area of desert and Gobi in Xinjiang. The correlation between Xinjiang shrub plant species richness and altitude is significant. As a whole, latitude, altitude mean value and altitude variation significantly affect the distribution patterns of shrub species richness in Xinjiang, with latitude having the strongest influence.

Linking Perception of Green Space Characteristics and Biodiversity With Well-being and Recreation in Order to Map Urban Cultural Ecosystem Services

Asa Ode Sang, Dept. of Landscape Architecture, Planning and Management, Swedish University of Agricultural Sciences; Marcus Hedblom, Department of Forest Resource Management, Swedish University of Agricultural Sciences, Sweden; Igor Knez, Department of So

Urban green spaces provide a wide variety of ecosystem services but are also under a constant threat through processes of densification and changes in transport infrastructure. For urban areas, the cultural ecosystem services are often expressed by planners and managers to be of special importance. There has been an increased recognition of the importance that green spaces has with regards to people's health and well-being, with green areas a setting for both physical activity and restoration. However, the connection between well-being and the more nuanced view of green spaces as for species, flora and biodiversity per se is less studied. Here we studied the connection between people's experience of green spaces in the city of Gothenburg and biophysical values related to biodiversity. In total 6 specific green spaces of varied characteristics were studied (size 1.8-3.5 ha). For each green space a survey was sent out to its near-by residents asking questions of people's perception and importance of different characteristics and associated feelings of well-being and recreational use of each green space respectively (N= 1347) Parallel to this, field inventories relating to different aspects of biodiversity were conducted including pollinators (bumblebees), birds, treespecies, tree dbh, treecover, shrubs, dead trees and flora. The responses from the survey is analysed together with field data and results on the relationship between perception of the green space with regards to aspects of naturalness and

stewardship, different aspects of measured biodiversity and cultural ecosystem services such as recreation and well-being will be presented.

Simulating Feedbacks Between Human and Natural Disturbance Using the CHANGE Model

Michael C. Wimberly, South Dakota State University; Terry L. Sohl, United States Geological Survey; Zhihua Liu, South Dakota State University*

Global change will have significant impacts on ecosystems worldwide, and natural and anthropogenic disturbances will be key drivers of these dynamics. In addition to climate change, continual encroachment of human populations into forest ecosystems will alter fire regimes, increase human vulnerability, and constrain future management options. A comprehensive and integrative coupled human and natural systems modeling approach is thus required to project future landscape changes and study their causes and consequences. In particular, existing landscape models must be extended to simulate multiple processes and interactions, including human-driven land cover and land use changes, land management practices, succession of natural communities, and natural disturbances such as wildfires. To address this need, we developed the Coupled Human and Natural Geospatial Environments (CHANGE) model. This raster-based, spatially explicit, stochastic computer model is programmed in C++ and combines a demand-allocation land use change module, a succession module for natural vegetation dynamics, and a spatially explicit fire initiation and spread module. The CHANGE model has been applied to project future wildfire risks under alternative scenarios of wildland-urban interface (WUI) expansion and climate change in the Colorado Front Range. It has also been adapted to simulate deforestation arising from the interaction of agricultural expansion, forest degradation, and wildfire in the Upper Guinean Forest region of West Africa. Results from these case studies offer insights into the landscape-level interactions between human and natural systems and suggest ways in which these internal feedbacks can either amplify or constrain the effects of climate change on landscape structure and dynamics.

Factors Promoting Avian Mortality at Wind Turbine Structures: Insights From Long-Term Avian Mortality Data in the Federal State of Brandenburg, Germany

Anushika Bose, UFZ - Helmholtz Centre for Environmental Research: Department of Conservation Biology; Klaus Henle, UFZ - Helmholtz Centre for Environmental Research: Department of Conservation Biology; Reinhard A. Klenke, UFZ - Helmholtz Centre for Envir*

Biodiversity related impacts at wind energy facilities have increasingly become a cause for serious conservation concern, the central issue being the slaughter of a large number of birds. We aimed to identify the major factors that confer high fatality risks to birds at wind farms. For this purpose, we combined species distribution modeling with assessments of bird mortality data estimated by carcass searches around wind turbines, to estimate their linkages to the ecological conditions at the respective turbines located in the federal state of Brandenburg, Germany. We quantified mortality in relation to sets of independent ecogeographical variables; climatic, topographic and habitat distance based, taking into account the probable environmental characteristics that might influence avian mortality at the wind turbine structures. For these analyses; firstly, we grouped the available bird carcass data exclusively for the "Birds of Prey: Raptors" owing to their higher number of comparative fatalities recorded from 2000 to 2011. Secondly, we developed predictive models to determine hotspot areas with higher risk of fatalities and assessed the optimal set of ecological factors promoting it. The approach, not only provided valuable insights by ranking and subsetting the optimal set of explanatories that best explained the variations in the mortality data, but also highlighted strengths of interactions amongst them, delineating the probable root cause of the conflict. Besides this, the subsequent results could even be

used to direct future energy development at minimal bird expense by directing safe and smart wind turbine installations based on welfare optimality between; energy potential benefits and avian welfare.

Assessing the Relationship between the Expansion of Urban Heat Island and Land Use Change by Landscape Metrics

Hao-Wei Chiu, Graduate Institute of Urban Planning, National Taipei University ; Chia-Tsung Yeh , Graduate Institute of Urban Planning, National Taipei University ; Shu-Li Huang, Graduate Institute of Urban Planning, National Taipei University*

Urban heat island (UHI) is one of the major challenges for achieving urban sustainability. Higher temperature in urban area impacts on GHGs emissions, energy consumption, and thermal comfort for residents. According to the latest 5th IPCC report, reducing UHI has a co-benefit to decreasing GHGs emissions. Thus, measuring and mitigating the UHI effect are greatly important issues for urban planning and urban ecology studies. The main objective of this study is to investigate the expansions of UHI and their relationship with land use change in northern Taiwan. In this study, Landsat images from 1987 to 2010 were selected to retrieve urban temperatures. The spatiotemporal patterns of UHI distribution and land use change were analyzed by landscape metrics. The results show that built-up areas have expanded in the past 24 years, and the sprawl of UHI was along with urbanized process. The expanded areas of UHI, which were observed at the peri-urban area around the city center of Taipei, were explicitly presented through operating UHI overlay maps. This research results will also present that using landscape metrics analysis is an effectively method to analyze the distribution of UHI.

The impact of landscape heterogeneity on heavy metalcontamination in agricultural top soils at multiple scales in the Pearl River Delta, China

Cheng Li, Guangdong Institute of Eco-Environmental and Soil Sciences; Fangbai Li, Guangdong Institute of Eco-Environmental and Soil Sciences; Zhifeng Wu, Guangzhou University; Ge Sun, USDA Forest Service; Jiong Cheng, Guangdong Institute of Eco-Environme*

Soil contamination is one of the serious environmental problems due to rapid industrialization and intensive agriculture in the Pearl River Delta region in southern China. We hypothesize that landscape patterns influence soil contamination magnitude and processes through the spatial variations of the composition and configuration of the landscape (i.e., landscape heterogeneity) on multiple scales. This study characterized the status and spatial distribution of agricultural soil contamination with As, Pb, Cd, Cr and Ni and quantified the impacts of landscape heterogeneity variables on heavy metal contamination and the variance portioning of soil contamination controlled by three interactive variable groups on coarse, medium and fine-grained scales. We collected agricultural top soil samples at 1384 sites in 2005. The correlation and partial redundancy analyses were performed at four difference pollution scales. Of the 1384 soil samples, 20.6-62.9% of the samples were considered to be polluted by all five heavy metals at uncontaminated to moderate and moderate levels, and samples with high pollution were primarily found in areas near old industrial bases. The heavy metal contamination levels differed in different agricultural land use types, and soil contamination with at least some of the heavy metals presented significant correlations with most of the landscape heterogeneity variables on different spatial scales. The landscape heterogeneity variables explain 16.3-46.8% of soil contamination variations on multiple scales, with an increasing explanatory power from fine to coarser scales. The contributions of three landscape heterogeneity variable groups (i.e., land use, parent materials and distance-density variable) to soil contamination are apportioned differently across the scales, and the pure effects of both land use and distance-density variables together account for 17-30% of the explained variations. Although the landscape heterogeneity variables are insufficient to characterize the

stochastic processes that cause soil pollution at finer scales, they could be used as proxies of soil heavy metal pollution at coarser scales. Our findings also indicate that land use management can be employed for soil contamination remediation purposes.

Location, Connectivity, and Land Use of Future Coastal Wetland Migration Corridors within the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative

Kereen T. Griffith, Griffith Consulting at U.S. Geological Survey; Michael J. Osland, U.S. Geological Survey; Nicholas M. Enwright, U.S. Geological Survey*

Coastal wetlands within the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative (GCPO LCC) provide regionally-important ecosystem goods and services, including habitat for fish and wildlife species, seafood, improved water quality, carbon storage, recreation, and shoreline protection. Though these historically resilient ecosystems have been able to adapt to past sea-level fluctuations via vertical and horizontal movement on the landscape, current and projected anthropogenic barriers are expected to limit adaptation to future sea-level rise (SLR) in some coastal reaches. Projections of accelerated SLR and coastal urban development indicate that there is a need for future-focused information that can be used to facilitate coastal wetland adaptation. This study focused on a coastal reach of the northern Gulf of Mexico that extends from Bay St. Louis (Mississippi) to the Apalachicola Bay (Florida). Using projected future SLR and urbanization scenarios, we developed models to identify: (1) where tidal saline wetlands are expected to migrate landward in the future; (2) the current land use and land ownership of these future migration corridors; and (3) the connectivity of these corridors to existing Federal and State-owned lands (e.g., National Estuarine Research Reserve, National Wildlife Refuge, National Seashore, and Water Management District lands). Our results show that, in the coming century, SLR and coastal urbanization will greatly alter coastal landscapes. This work provides foundational information that can be used by coastal conservation planners within the GCPO LCC to better understand and prepare for coastal wetland landward migration in response to future SLR.

An LCD in mid-development: Transboundary Cascadia Partnership

Jen Watkins, Conservation Northwest

Formed by practitioners in Washington and British Columbia's Cascade mountains in the summer of 2012, the Cascadia Partner Forum fosters a network of natural resource practitioners working with the Great Northern and North Pacific Landscape Conservation Cooperatives to build the adaptive capacity of the landscape and species living within it. The objectives of the partner forum are to identify and prioritize science and management needs and resources to increase adaptive capacity in the Cascadia landscape; highlight successes and challenges in implementation of adaptation actions; facilitate communication to share ideas and expand implementation of adaptive actions including identification of new approaches; and draw attention to this unique landscape. In 2015 the forum aims to forward conservation design for four conservation targets with significance to the transboundary Cascadia landscape to inform sound, data-driven management planning and action. This project aims to complete conservation design at the Cascadia-wide scale for grizzly bear, salmon, aquatic, and terrestrial connectivity to contribute to the Great Northern LCC Science Plan, while providing input and integration to the courser scale GNLCC-wide Science Plan's established objectives, threats, metrics, and conservation actions for each target. Additionally we propose to conduct analyses on a common landscape stressor - roads - within Cascadia that land and species managers have identified science needs for to apply with stakeholders in planning efforts aimed at addressing and mitigating their impact. For more information visit www.cascadiapartnerforum.org

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Modelling adaptation strategies for Swedish forestry under climate and global change - An agent-based approach

Victor Blanco, University of Edinburgh; Calum Brown, University of Edinburgh; Gregor Vulturius, Stockholm Environment Institute; Mats Lindeskog, Lund University; Fredrik Lagergren, Lund University; Mark Rounsevell, University of Edinburgh*

Our planet's land surface is today under intense pressure, subject to the demands of a growing human population and to changing patterns of consumption. These demands drive competition for a limited land resource between food producers, resource extractors, nature conservationists or urban developers amongst others. In Sweden, forests are among the country's most valuable natural resources. The Swedish forestry sector is expected to be significantly affected by climate change, while demand for woody biomass is anticipated to vastly exceed the potential supply in Europe by 2030, putting a very high pressure on Swedish forest resources and likely forcing difficult trade-offs between forestry policy goals. Under such uncertain prospects there is an obvious need for further in-depth studies of potential future forestry-related land use transitions in Sweden, to better understand possible changes in future forest management and service provision. Given the importance of incorporating human behaviour and decision-making processes to the study of complex socio-ecological systems we have developed an agent-based model (CRAFTY-Sweden) that allows us to explore Swedish land-use dynamics through scenario analysis. In CRAFTY-Sweden land managers make land use and management decisions according to their objectives and capabilities. As a result of their management and location characteristics (i.e. capitals) they are able to produce ecosystem services. Institutions may also influence the system through their actions.

Closing Group Discussion

All participants

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Ecosystem based information system and treeline area-related ecosystem services covering sensitive mountain areas in Bulgaria

Karsten Grunewald, Leibniz Institute of Ecological Urban and Regional Development, Germany; Miglena Zhiyanski, Stoyan Nedkov - Bulgarian Academy of Sciences

For the future conservation of sensitive mountain regions and continuous ecosystem service provision, stakeholders need detailed information about ongoing changes based on indicators from studies in representative areas. Under current global change, including changes in human land use linked to widespread abandonment of agricultural and forestry activities in Bulgaria, and expected increased summer temperatures and shifts in precipitation patterns, a re-balancing of the highland-lowland interactive systems in terms of population, land and resource use is likely to occur. In this context a Bulgarian-German consortium aims:
1. at establishing an observational network of existing field sites and experiments in selected sensitive mountain regions in Bulgaria (National parks of 'Rila', 'Pirin' and 'Central Balkan'), where parameters relevant to this bilateral project are analyzed;
2. to demonstrate the applicability of spatial and temporal indicators for selected ecosystem services in representative sensitive mountain regions in Bulgaria;
3. to develop an ecosystem-based information system including climatic, dendrochronological, biogeochemical, limnological and periglacial datasets of selected sensitive mountain regions in Bulgaria

to pave the way for capturing the complex interactions of climate and biogeochemical cycles in mountain regions at detailed scales.
The poster explains the project design (modules) and expected as well as preliminary results:
Â- Preliminary ecosystem services assessment and mapping in case study areas was carried out using a matrix approach that comprises land cover classes and their capacities. The ecosystems and their capacity to supply services were assessed using relative scale and the results were presented as maps of ES supply.
Â- Study the effects of land-use change in three representative mountain regions: Case-studies and precise characterization of soil, forest floor and above ground components of ecosystems, identify indicators.
Â- Climate observation: Improvement of climate measurements; local studies.
Â- Treeline, dendroecology: Develop and analyze robust tree ring chronologies from sensitive mountain areas; study natural forest history and dynamics including disturbance regimes.

Analysis on the Relationship between the Pattern of Green spaces and Land Surface Temperature

Lei Wang, University of Heilongjiang Science and Technology;Shuwen Zhang, Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences*

Using SPOT5 images and the Landsat TM, we selected the Normalized Difference Vegetation Index (NDVI) and Land Surface Temperature (LST) as indices of vegetation cover in urban green space and the effect this cover has on temperature. We analyzed the spatial distribution of green spaces varying NDVI levels in Changchun city, China, and further explored the correlation between green space NDVI value and the LST using the spatial analysis in GIS. The results showed that the NDVI value of all green spaces to be negatively correlated with LST, but significant variation existed within this trend. The spatial distribution of urban green spaces by their types and their compositions had an important influence on the urban thermal environment. The NDVI values were highest among tree nurseries and agricultural land, which had low corresponding LST, while LST was highest in the residential green spaces. The vegetation coverage and the LST of green patches were quantitatively analyzed for the entire study area, and the result revealed that green spaces in urban parks had a much greater impact on LST than other types of urban green space. Within urban green spaces, evergreen forest lands had the highest NDVI values and the largest cooling effect on land surface temperature, followed respectively by deciduous forest lands and agricultural croplands, with grasslands having the lowest NDVI values and producing a minimal effect on land surface temperature. Thus evergreen forest had a greater cooling impact on LST than deciduous forests, croplands and grasslands.

Landscape assessments based on biodiversity, ecosystem functions and ecosystem services

Benjamin Burkhard; Felix Muller; Kiel University*

Ecosystem services have become a highly popular topic in science and they hold a high potential for environmental management. What is often lacking are consistent frameworks, respective indicators and tools that are applicable in assessments and policy making, quantifying and visualizing landscape biodiversity, ecosystem functions and services appropriately and on different spatial and temporal scales. It is necessary to know and to indicate where ecosystem services actually are supplied and which is the geobiophysical base (biodiversity and related ecosystem functions) for this provision. Relevant policy instruments such as the Biodiversity Strategy of the European Union, Payments for Ecosystem Services (PES), carbon offsets and trading as well as conservation or compensation auctions, depend on robust quantification and information about goods and service supply, demand and flows. Each piece of land can be dedicated to a limited (or single) amount of land-uses only. Therefore decision makers need

to understand where and what goods and services are provided in a certain landscape and what are societal demands for ecosystem services. Maps and spatially explicit models allow the assignment of ecosystem service supply and demand data to particular multifunctional landscape units. The presentation will show methods and indicators of quantifying, modelling and mapping biodiversity, ecosystem functions and services, integrating geobiophysical information as well as social and economic data. The "ES matrix" approach has been applied in different international case studies (e.g. in Germany, Bulgaria, Finland, China, Southeast Asia,) in diverse landscapes and on various temporal and spatial scales.

Restoring Fire-Prone Landscapes: Seven Core Principles

Paul F. Hessburg, PNW Research Station (PNWRS); Andrew J. Larson, University of Montana; Derek J. Churchill, University of Washington; Ryan D. Haugo, The Nature Conservancy; Carol Miller, RMRS, Aldo Leopold Wilderness Research Institute; Thomas A. Spies,*

More than a century of forest management has radically transformed succession and disturbance dynamics of fire-prone western US landscapes. Regional connectivity of most terrestrial and aquatic habitats has been fragmented, flows of many ecological processes have been rescaled, and the frequency, size and intensity of disturbances that configure habitats have been altered. Climate warming and its effects add to uncertainty about future landscape dynamics and the resilience of ecosystems, native species, and people. Forest restoration efforts in the West are still influenced by a stand-scale perspective and yield a small footprint in comparison to large wildfires and insect outbreaks. Further, they emphasize forest thinning and fuels reduction while overlooking broad-scale habitat and disturbance connectivity considerations. We provide a framework for landscape restoration to address these concerns, offering seven core principles. We discuss their implication for management, and illustrate their application with examples. We show that historical fire-prone western US forests were spatially heterogeneous at multiple scales. This heterogeneity was the result of variability in native ecological and physical processes, including climatic, successional, and disturbance regimes. Native flora and fauna were adapted to these heterogeneous conditions, which conferred both resistance and resilience to further shifts in climate and recurrent contagious disturbances. Hence, re-establishing high-functioning, multi-level patterns, processes, and dynamics is a key to landscape restoration. To restore resilience of current fire-prone landscapes, planning and management are needed to correct changes in patterns and processes at ecoregion, local landscape, successional patch, and tree neighborhood scales. Moreover, restoration projects that effectively work across ownerships, allocations, and access needs will require that we actively think about landscapes as socio-ecological systems that provide services to people within the finite capacities of ecosystems. We introduce an idea new to planning and management, that landscape-level prescriptions are foundational to restoration.

Heterogeneity, scale and landscapes: Homage to a creative thinker

Monica G. Turner, University of Wisconsin-Madison*

Perhaps no other scientist has had greater influence on conceptualizing how populations respond to spatial and temporal heterogeneity and how organisms scale their interactions with the environment than John A. Wiens. Throughout his career, Wiens has combined deep understanding of organisms (especially birds) and their natural histories with incisive thinking to produce novel insights that catalyzed much subsequent research. His 1976 article in ANNUAL REVIEW OF ECOLOGY AND SYSTEMATICS introduced many of us to new ideas about populations in patchy environments and was way ahead of mainstream ecology; this paper still makes for excellent reading today. His 1989 article in FUNCTIONAL ECOLOGY argued effectively for viewing the world at multiple scales based on the

organism or process of interest. Wiens established an organism-focused definition of scale and conceptual framework that guided population ecology for decades and helped lay the foundation for landscape ecology. Although his main emphasis was on populations, Wiens made important contributions relevant to other levels of ecology. For example, the 1985 paper in OIKOS focused on boundary dynamics and lateral fluxes and considered population and ecosystem processes. Wiens' intellectual leadership and broad perspective are evident in his contributions to commentaries in the 2007 edited volume, FOUNDATION PAPERS IN LANDSCAPE ECOLOGY. This presentation will synthesize the symposium and offer personal reflections on how John Wiens' work influenced my thinking as well as the development of landscape ecology.

Introduction to John A. Wiens Symposium

Nancy E. McIntyre, Jianguo (Jack) Liu and Helene Wagner

This symposium will honor Dr. John A. Wiens for his lifetime contribution to landscape ecology. Dr. Wiens recently retired as Chief Conservation Science Officer with PRBO Conservation Science, is the Winthrop Research Professor at the University of Western Australia, and University Distinguished Professor (Emeritus) at Colorado State University. As a former President of IALE, organizer of the 1999 IALE World Congress, and recipient of many honors and awards, including the Distinguished Landscape Ecologist Award, Distinguished Service Award, and Best Paper in Landscape Ecology Award from US-IALE, Dr. Wiens has made seminal contributions to the fields of landscape ecology, restoration ecology, community ecology, arid-land ecology, and avian ecology. This symposium will focus on research and applications inspired by one of Dr. Wiens's classic papers entitled "Spatial Scaling in Ecology" (Functional Ecology, 1989, 3(4): 385-397). This paper has been cited in over 1,900 journal articles. The symposium will bring together a broad range of scientists, all of whom have been mentored by Dr. Wiens or otherwise influenced by him. The presentations will focus on work as motivated by Dr. Wiens's ideas on the importance of scaling in ecology, conservation, and management.

Influence of climate variability and landscape composition on water supply and quality in Sao Paulo, Brazil

Maria Uriarte, Columbia University, USA; Leandro Reverberi-Tambosi, University of Sao Paulo, Brazil; Jean Paul Metzger, University of Sao Paulo, Brazil

Ensuring an adequate supply of water resources for humans and ecosystems represents a pressing environmental challenge. Any effort to ensure the sustainable use of this critical resource must take into account the compounded effects of climate variability, particularly precipitation, and human land-use dynamics on water supply and quality. Using bi-monthly data from 45 water monitoring stations collected between 2000 and 2005, we quantified how climate variability, particularly the frequency of extreme precipitation events, the composition and configuration of the landscape (proportion of native forest, sugarcane plantations, exotic forest plantations, and urban areas), and geological substrate influence water flow and quality in the streams of nine large watersheds of the state of SÃ£o Paulo, Brazil. High precipitation events were positively associated with stream water flow and turbidity, increases in the concentration of iron and aluminum, and reductions in nitrogen. Relative to native forest cover, water flow was lower in watersheds dominated by Eucalyptus plantations especially during dry years. Exotic plantations and sugarcane cultivation were also associated with greater turbidity and higher concentration of nitrogen and phosphorus in streams. Degradation of water quality, namely higher nitrogen and phosphorus and lower dissolved oxygen was evident in areas dominated by urban cover. The recent drought in the state of SÃ£o Paulo together with predicted declines in precipitation in

the region highlight the importance of watershed management for sustainable water provision in these landscapes.

Challenges of adopting an organism perspective for plants

Helene Wagner, University of Toronto; Adam S. Hadley, University of Toronto and Oregon State University

Animal ecologists have embraced the ideas of adopting an organism perspective and defining relevant scales separately for different processes much more readily than have plant ecologists. As plants are sessile, the space within which they perceive their environment has primarily been defined by the patterns of their above-ground shoot space and below-ground root space rather than on the processes generating those patterns. In fact, much plant ecological research is based on generic 1 m2 quadrats irrespective of the type of plant or the process being studied. To overcome this view, we will draw on recent findings that suggest, at the individual level, that plants are active organisms, and at the population level, that plant traits shape landscape-scale processes. While plants are commonly considered as passive organisms, recent findings from plant neurobiology suggest that individual plants can accurately process information, use cost-benefit analysis, and take action, including active foraging and territorial behavior. At the landscape scale, today's high resolution molecular data allow us to study how plants interact with their surrounding landscape through the processes of pollination and seed dispersal. We will show an example where hummingbird-pollinated Heliconia tortuosa selects for pollinators that forage across a landscape and excludes local pollinators. Thus, even though plants rely on biotic or abiotic vectors for pollination and dispersal, their reproductive traits may nevertheless shape plant interactions with the landscape in complex ways.

Using site-based spatial planning to enhance population viability for an endangered butterfly

Cheryl B. Schultz, Washington State University, Joseph Smokey; Washington State University; Elizabeth E. Crone, Tufts University*

Understanding of dispersal behavior should drive conservation planning for many at-risk species in fragmented landscapes. For some species and habitats, designing restoration strategies requires spatial planning not just at the landscape level, but also at the site-level. We seek to address questions posed by USFWS and other interested parties about the importance of spatial planning in establishing reproductive resources for an endangered Oregon butterfly, Fender's blue (Plebejus icaricia icariodes). In particular, spatially implicit modeling predicts that the butterfly requires 6 Ha of high quality reproductive habitat for persistence. We use a spatially-explicit individual based model (SEIBM) parameterized with demography and dispersal behavior from prior field studies to ask: 1) if the 6 ha patch needs to be a single patch vs. multiple smaller patches and 2) the degree to which smaller patches can be spread across a site for a butterfly population to persist at that site. We find that multiple smaller patches, if closely, spaced, lead to higher probability of persistence than a single patch, but that spreading the patches too far apart results in population extinction. These results are sensitive to boundary behaviors of the butterfly in which butterfly movement is biased at patch edges to return to reproductive habitat. A key outcome of this work for local planning agencies is that 6 ha of reproductive habitat planted across a 40-50 ha site can be arranged across a large diversity of designs, but that population viability is sensitive to details of spatial planning if strategies spread reproductive habitat over larger areas. This framework provides an approach for conservation planning of other at-risk species in which active restoration strategies can be designed in concert with behavioral ecology of those species.

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Context and consequences of bark beetle outbreaks and fire in the Lake Tahoe Basin

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In recent decades, large scale bark beetles outbreaks have caused significant damage across the Western US and Canada. These outbreaks, which at their most widespread can stretch over hundreds or thousands of square kilometers, are highly dependent on a confluence of factors for initiation, including proper climate conditions (i.e. drought) and forest community attributes (i.e. sufficient host species density). The forest of the Lake Tahoe Basin have seen outbreaks of several distinct beetle species over the last 30 years. We were interested in the differing effects of these unique beetle species on landscape forest community composition and potential interaction with fire and fuels management. We used the LANDIS-II modeling framework to project bark beetle outbreaks and fire. Beetle activity level is highly dependent on the density of suitable hosts, with Fir Engraver beetle showing the largest outbreaks in the absence of fuels management. With fuels management, Jeffrey Pine Beetle outbreaks increased in size as a result of increased Jeffrey pine biomass. Though beetle-kill created standing and downed fuels, there was little spatial overlap between simulated fires and beetles such that insect outbreaks had little to no effect on fire behavior. Our results highlight the importance of considering landscape context when studying multiple potentially interacting disturbances, particularly in cases such as insect outbreaks where the impacts are partially biotically-mediated.

Closing Discussion and Q&A

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Urban Terrarium: From human dominated landscapes to neighborhood ecosystems

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Simulating landscape dynamics in pasture-woodlands of the Southern Carpathians following land use and climate change

Ioana Stoicescu, Alina Tudor-Hossu, Ileana PÄftru-Stupariu; Mihai-Sorin Stupariu - Research Institute of University of Bucharest, ICUB; Transdisciplinary Research Centre Landscape-Territory-Information Systems, CeLTIS; Alexandre Buttler; Alexander Pering*

In Romania, where traditionally managed wood-pastures can still be found, a process of landscape transition has started, which drives land-use change towards either intensification or abandonment. Our research focuses on the South-Carpathian mountain ridge of Romania, where two selected study sites illustrate the above-mentioned situations of landscape segregation. The first study area, located in Fundata (Bran Passageway), pictures the loss of wood pastures to forest due to encroachment, whereas in the second selected location (TopleÈ›, CaraÈ™-Severin County), the landscape undergoes segregation into treeless pasture and forest, due to intensification and cutting down the characteristic single trees. The spatially-explicit model WoodPaM, developed by F. Gillet, A. Peringer et al. (2008), has been adapted to the environmental conditions of the two selected Carpathian locations and used to simulate pasture-woodland landscape transitions. Implementing WoodPaM requires knowledge on herb layer dynamics, tree regeneration and impact of cattle activities, allowing for the simulation of silvo-pastoral landscape evolution. We conducted a cumulated analysis of land-cover change (at several temporal scales), geo-morphological constraints and fine-scale developments of vegetation structure, based on

high-resolution LiDAR data. By relating long-term developments with short-term dynamics of vegetation succession, we are able to suggest causalities based on the relevant ecological processes.

Effects of biofuel forest management on biodiversity

Ashton Drew, North Carolina State University; Jennifer Costanza, North Carolina State University*

Biofuel and wood pellet production have been identified as growth industries in the Southeast. The potential for significant biodiversity impacts is acknowledged but uncertain, as many of the proposed crop types and production practices are novel to the region. We evaluated potential biodiversity impacts of biofuel production by using (1) state-transition models to predict possible landscape-scale changes in habitat availability (land cover and configuration), and (2) expert-based logistic regression models to predict possible plot-scale changes in habitat quality (food and shelter resource provisioning) for a subset of avian species in North Carolina. We measured significant differences among species' responses to alternative landscape-scale and plot-scale production alternatives. Our presentation focuses on the expert-based models to demonstrate how expert-informed prior estimates can provide a foundation for hypothesis-driven research or monitoring programs within an adaptive management framework when empirical data are too limited to establish data-driven best management practices. Specifically, where the landscape-scale models predict negative impacts to certain suites of species, we use the plot-scale models to explore and propose possible best-management practices to reduce impacts to these species.

Emulating natural forest disturbances in landscape management in Canada

Lisa J. Buse and Ajith H. Perera, Ontario Forest Research Institute, Canada*

Nearly half of Canada's managed forest landscape is now subject to the policies of emulating natural forest landscape disturbances (ENFD). While specifics vary, the Canadian provinces of Alberta, British Columbia, New Brunswick, Ontario, and Quebec have adopted this approach of designing forest harvest strategies based on spatial patterns of natural disturbances, primarily wildfire. In this presentation we focus on Ontario, where ENFD policy has shaped its managed forest landscape of >28 million ha. This policy evolved under a legislative act on forest sustainability, and was one of the first applications to formally incorporate broad spatial and long temporal contexts into forest harvest design. After a decade of its application, a second generation of ENFD policy was released in 2012. Specifically, here we: 1. detail the formulation, application, and revisions of the ENFD-based policy, 2. discuss the scientific, economic, and socio-political challenges faced during its development and application, 3. describe its vast effect on forest landscape patterns that may last for centuries, and 4. highlight the remaining scientific knowledge gaps and uncertainties associated with its practice.

Integrating Landscape Metrics to Understand and Map Fragmentation in a Brazilian Watershed

Julia Arieira, Universidade de Cuiaba; Luciana Estevam, The Nature Conservancy-Brazil*

The Brazilian cerrado has suffered the highest deforestation rates observed in Brazil, causing fragmentation and loss of habitats. With this study we produced and mapped a fragmentation index (FI) for a watershed in the central-western Brazil through the integration of landscape metrics and the use of GIS. This study was conducted using data of a land-cover map at 1: 250,000 scale. Nine uncorrelated metrics were calculated for 120 regions of 25 km2, using hexagonal mask overlapped to the Basin area, and Principal Component Analysis (PCA) was applied to the matrix of metrics to investigate fragmentation patterns and measure the importance of each metric in fragmentation patterns. The normalized metrics data were integrated into a weighted sum equation to determine the IF for the whole Basin. The IF ranged from -1.75 to 1.83, representing the fragmentation gradient, from less

fragmented areas, with the larger area occupied by cerrado and greater patch connectivity; to the more fragmented areas, with larger and more isolated fragments. Standard deviation of the IF applied to a test data set, indicated that greater uncertainties in IF occur where the diversity of cerrado vegetation (Shannon index) is greater, showing that the importance of diversity in explaining landscape fragmentation processes vary widely.

Characterising gap-crossing distances between fine-scale landscape elements such as scattered trees for connectivity modelling

Alex M. Lechner, Centre for Environment, University of Tasmania, Australia, Centre for Social Responsibility in Mining, University of Queensland; Edward C. Lefroy, Centre for Environment, University of Tasmania, Australia*

Fine-scale landscape features such as scattered trees and roadside vegetation corridors are increasingly thought to be important for movement between habitat patches. However, existing connectivity modelling approaches fail to adequately account for fine-scale features and gap-crossing behaviour. We present a method for modelling connectivity at fine spatial resolutions over large spatial extents. Our method is based on a novel approach to characterising fine-scale dispersal behaviour within the context of existing modelling methods. We address computational limitations through the creation of a gap-crossing threshold layer, which identifies areas where dispersal is possible because of the presence and spacing of fine-scale connectivity elements. The gap-crossing layer is created through a simple buffering geo-processing method of high spatial resolution data describing these fine-scale features. This layer is combined with a dispersal cost layer and can then be used as an input within common graph-network least-cost path analysis methods. We provide examples of how this approach can be used within the Graphab software modelling connectivity using an interpatch-dispersal distance threshold for a range of gap-crossing distances. We demonstrate the impact of the inclusion of the gap-crossing layer through testing a range of scenarios with and without the gap-crossing layer and for a number of gap-crossing distances. The inclusion of fine-scale connectivity elements allows for the assessment of lower quality habitat that are often unprotected, such as those made up of scattered trees in grazing lands. These features may be otherwise be excluded from conservation assessments as they may make little contribution to biodiversity.

Effects of Grain for Green on soil erosion in Guanchuanhe River Watershed on Loess Plateau Region, China

LI Hai-fang, Chinese Academy of Sciences; CHEN Li-ding,Chinese Academy of Sciences.*

Soil erosion is one of the most serious ecological and environmental problems in the Chinese Loess Plateau. Vegetation plays an important role in controlling soil erosion. Base on the observed data from monitoring stations and the published data from other research, we conducted a study at watershed of Guanchuanhe River, a typical region of Loess Plateau. We applied the Revised Soil Loss Equation (RUSLE) to assess soil erosion in a Geographic Information System (GIS). Our results showed that: 1) The land use had undergone a general shift from farmland to woodland or grassland. 2) Soil erosion was different for the studied vegetation conditions, decreasing as canopy and ground cover increased. Runoff was reduced by 87%, 87% and 98% and soil loss by 97%, 93%, and 99% respectively, as compared to the Control. 3) Soil erosion was negative linearly correlated with vegetation coverage (r=0.99**), while vegetation was mainly associated with human activities. Testing the model performance indicated that dynamics of vegetation coverage and soil erosion in the Loess Plateau of China could be precisely simulated. 4) It was found that the WATEM/SEDEM model performs poorly in predicting erosion amounts for each raster cell used for the modeling, but is more reliable in predicting the spatial pattern

of erosion. The information of this study can be useful for better understanding the relationships between vegetation and water loss and soil erosion.

Assessing the Effect of Urbanization on Urban Diurnal Land Surface Temperature Difference Using Remote Sensing Images

Yen-Ching Chen,Fu-Jen Catholic University; Hao-Wei Chiu, National Taipei University; Ke-Sheng Cheng, National Taiwan University

Landscape changes and the degree of urbanization in the Taipei City between 1994 and 2010 were assessed using SPOT and MODIS satellite images. An urbanization index which integrates the percentage of built-up land cover and NDVI was used to provide a quantitative evaluation of the degrees of urbanization over a period of 17 years. Diurnal land surface temperature (LST) differences were assessed using MODIS images. Notwithstanding the significant uncertainties, diurnal LST difference tends to increase with the urbanization index. However, changes in the diurnal LST difference become negligible in the higher urbanization index range, suggesting that mitigation of the adverse effect will be less effective unless the urbanization index is reduced to approximately 0.6 or lower. Urbanization is likely to result in a higher increase in urban heat absorption than increase in thermal inertia. Thus, measures, such as increasing green space, that can effectively reduce urban heat absorption should be given higher priorities in mitigating the urban heat island effect.

A continental United States high resolution NLCD land cover - MODIS albedo database to examine albedo and land cover change relationships

J. Wickham, U.S. EPA;C. Barnes, USGS*

Surface albedo influences climate by affecting the amount of solar radiation that is reflected at the Earth's surface, and surface albedo is, in turn, affected by land cover. General Circulation Models typically use modeled or prescribed albedo to assess the influence of land cover on climate. Empirical observations of albedo as a function of land cover are generally lacking. We developed a high resolution (~500m-x-500m) database of geo-registered land cover and albedo using the National Land Cover Database (NLCD) and MODIS (MCD43A) data. NLCD land cover includes all three eras (2001, 2006, 2011) and 14 of 16 classes. MODIS data include all high quality snow-free and snow-covered observations from 2000 through 2013, and also include all six expressions of albedo (black sky and white sky for visible, near-infrared, and shortwave). Conflation of the three NLCD eras was used to assess the effect of land cover change on albedo. The database includes ~9,800 land cover change observations covering many of the plausible NLCD land cover conversions. Preliminary results indicate conversion of forest to herbaceous (cropland, pasture, grassland) leads to an increase in surface albedo, but the albedo change signal is not always detectable.

Assessing the Role of Indicators and Connectivity for Conservation Planning of Southeastern U.S. Pine Woodlands and Savanna

Bradley A. Pickens, C. Ashton Drew -North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University; Louise Alexander-Vaughn, North Carolina State University; Amy Keister, South Atlantic Landscape Conservation Cooperative; Rua*

Systematic conservation planning efforts are valuable for efficiently allocating conservation actions given the restraints of limited resources. The South Atlantic Landscape Conservation Cooperative is using this approach to develop a shared Conservation Blueprint for the region spanning from southeast Virginia to northern Florida, USA (~90 million hectares). The goals of the approach are to assess current

conditions by using ecological and cultural indicators, and then to incorporate future projections of threats to optimize conservation strategies. Here, our objectives were to: 1) use indicators of pine bird index, open canopy and burned areas, priority amphibian and reptile conservation areas, resiliency, low road density, and historic places to prioritize hotspots of ecological and cultural integrity within the range of historic longleaf pine savanna; 2) use cross-validation to determine if indicators are effective and robust; 3) test the effect of boundary length penalties; 4) examine conflicts with projected urbanization by 2050. We used Zonation to conduct optimizations of the pine ecosystem. This software uses the concept of minimizing marginal loss to produce a spatial prioritization at a relatively fine scale. The cross-validation results showed the prioritization was relatively robust to changes in indicators, and thus, demonstrates that indicators can be effective for prioritizing pine habitats. Greater amounts of connectivity, characterized by the boundary length penalty, did improve the correlation between the full model and leave-one-out model in some cases. Finally, we demonstrate how an urbanization scenario can be integrated with the spatial prioritization to further refine the selection and location of conservation actions.

Spatial heterogeneity of burn severity in forests of the Northern Rocky Mountains (1984-2010)

Brian J. Harvey, University of Colorado-Boulder

Wildfires produce tremendous heterogeneity in burn severity that governs forest-landscape structure and function. Climate change is increasing wildfire frequency and area burned, but little is known about the controls on spatial heterogeneity of burn severity and/or whether heterogeneity is changing during a period of increased fire activity. In this study, I characterized spatial heterogeneity of burn severity (stand-replacing fire) for all fires in the US Northern Rocky Mountains to ask the following questions: 1) How does spatial heterogeneity vary by forest type? 2) What are the dominant controls of spatial heterogeneity in burn severity? 3) Is spatial heterogeneity and/or the primary drivers of heterogeneity changing over time? Subalpine forests exhibited more stand-replacing fire, and larger, simpler shaped stand-replacing fire patches than mid-montane forests. Most metrics of spatial heterogeneity of stand-replacing fire were affected by fire size and proportion stand-replacing, but few changed over time. Climate was most important for driving spatial heterogeneity of burn severity in subalpine forests, whereas topography and climate were of more equal importance in mid-montane forests. Findings demonstrate quantifiable differences among forest types in the spatial patterns and drivers of wildfire severity. The importance of climate variables in driving fire size and proportion stand-replacing, combined with strong control of fire size and proportion stand-replacing on spatial heterogeneity of burn severity suggests that future fire patterns will change substantially in coming decades with potentially widespread consequences for forest landscape heterogeneity.

Agricultural landscape complexity and functional biodiversity is sustained by the exotic flora in the Rolling Pampa

Santiago L. Poggio, IFEVA / Catedra de Produccion Vegetal, Facultad de Agronomia, Universidad de Buenos Aires / CONICET, Buenos Aires, Argentina. Gonzalo A.R. Molina, IFEVA / Catedra de Ecologia, Facultad de Agronomia, Universidad de Buenos Aires / CONIC

The Pampas were homogeneous treeless grasslands whose vegetation heterogeneity was determined by topographic and climate gradients. Agriculture created complex farmlands that altered the natural heterogeneity and introduced new organisms assembling novel ecosystems. Our aim is highlighting the contribution of the exotic flora occurring in anthropic elements to retain biodiversity and ecological functions in farmlands of the Rolling Pampa. While croplands occupy about 90% of the mosaic area, anthropic elements such as fencerows, roadsides, and woodlots, occupy the remaining surface, which

sustain most of plant diversity in agro-ecosystems, particularly native plants. Woodlots, a novel elements in the Pampas, are important drivers of bird richness and abundance. Species richness and abundance of predator, parasitoid and pollinating arthropods are also greater in anthropic elements. Exotic flowering plants provide flower resources to native bees. There is evidence that dispersal from nearby habitats accounts for community assembly in croplands. Human activities have increased the abundance and frequency of anthropic elements sustaining biodiversity and ecosystem functions in farmlands. However, agricultural intensification is changing this trend by removing small landscape features retaining semi-natural habitats and impoverishing their habitat quality for wildlife. Initiatives to conserve biodiversity in the intensively managed agro-ecosystems prevailing in the Pampas should be focused on restoring and managing small uncropped landscape elements.

Offshore distance Gradient change effect of land use landscape pattern in Jiangsu coastal areas

CHEN Xinjian, School of Geographic and Oceanographic Sciences, Nanjing University, China

Land use landscape pattern reflects the mutual influence between human and nature. Jiangsu coastal area (offshore distance within 20km from coast line) in the east of China is chosen as our study area. Based on the TEM remote sensing imagery interpretation data in 2013 and techniques of GIS and related landscape analysis, This paper divides study areas into three landscape pattern types (agriculture, natural ecology and construction) and four sections (sectionâ… : 0-5km offshore distance, section â…¡: 5-10km offshore distance, section â…¢: 10-15km offshore distance and section â…£: 15-20 offshore distance). The conclusion tells that agriculture landscape is the most dominant landscape type while the nature ecology landscape pattern is the most subordinate one. The agriculture land shows an increasing trend from sectionâ… to section â…¢ but a decreasing trend from section â…¢ to section â…£. The nature ecology land shows an sharp decreasing trend from sectionâ… to section â…£. The construction land shows an decreasing trend from sectionâ… to section â…¡ and a increasing trend from section â…¡ to section â…£. From coast line to inland, the landscape indices comprised of PD, NP, ED, SPLIT increases while CONTAG, SHEI, COHESION, SHDI, PAFRAC decreases. To the whole area, the construction landscape is mainly an increasing type and the nature ecology landscape is a decreasing type. Seen from all landscape indices, the coastal land use landscape pattern is getting fragmental from coast line to inland while the complexity of components for each landscape type increases. The differences among all counties are mainly decided by section â…¡and â…¢ and landscape patterns of nature ecology and construction.

Key words: Land use; Landscape pattern; Offshore distance; Gradient change; Jiangsu coastal area

Observer error in vegetation surveys: A comprehensive literature review

Lloyd W. Morrison, Biology Department, Missouri State University

Vegetation surveys employing observers are conducted in many landscape studies. Such surveys are prone to both inter-observer and intra-observer error. I conducted a comprehensive literature survey (57 peer-reviewed articles) of the studies that have quantified these types of error. A strong geographical bias exists, as 74% of the studies were from Europe and North America; only 2 studies were conducted within the tropics. Almost all studies (92%) that tested for a statistically significant effect of observer error found at least one significant comparison. Although some studies found such error to be of a relatively small magnitude, many reported relatively large effect sizes. For example, in surveys of species composition, mean pseudoturnover (the percentage of species missed by one observer but not another) was 10 to 30%. The mean coefficient of variation among observers in surveys of vegetation cover was more variable, and often surpassed 50%. Species misidentification rates were on the order of 5 to 10%. A variety of metrics and indices (including commonly used diversity indices)

and multivariate data analysis techniques (including ordinations and classifications) were found to be sensitive to observer error. Sources of error commonly include both characteristics of the vegetation (e.g., small size of populations, geographical rarity, morphology, phenology) and attributes of the observers (e.g., mental fatigue, personal biases, differences in experience, physical stress). The use of multiple observers, additional training including active feedback approaches, and continual evaluation and calibration among observers are recommended as strategies to reduce observer error in vegetation surveys.

Applied conservation planning within a Romanian Natura 2000 wetland - lessons from a LIFE Nature project

Laurentiu Rozylowicz (1), Andreea Nita (2,3), Carmen Sorescu (4), Gabriel Chisamera (5), Cristiana Ciocanea (1), Steluta Manolache (1) (1) University of Bucharest, Center for Environmental Research, 1. Nicolae Balcescu, 010041 (2) Institute of Resear*

Located in the south-western of Romania, Natura 2000 site "Danube water course Bazias-Iron Gates" overlaps a large area of core habitats for pygmy cormorant (Phalacrocorax pygmaeus) and ferruginous duck (Aythya nyroca). The main threats for pygmy cormorant are the lack of suitable habitats for breeding and feeding. Hence, with the support of an EU LIFE Nature project (LIFE10 NAT/RO/00740) we developed a conservation project aiming at improving connectivity of suitable feeding and breeding habitats for pygmy cormorant and ferruginous duck, in order to achieve a suitable conservation status for the two protected species. In order to select key intervention areas for species conservation, we use landscape connectivity metrics appropriate for our study, taking into account movement data for pygmy cormorant and ferruginous duck and relevant environmental variables. The main conservation activities implemented in selected key intervention areas were: enlarging pygmy cormorant breeding habitats by replacing invasive tree species (e.g., Ailanthus altissima, Amorpha fruticosa) with native white willow (Salix alba); enhancing feeding and breeding habitats for ferruginous duck by reducing biomass of water plant species; enhancing connectivity of pygmy cormorant feeding and resting sites by installing drying platforms and cormorant decoys. Our results demonstrates how simple spatial tools and landscape ecology indices can help biodiversity conservation practitioners to select key intervention areas and to implement viable and cost effective conservation programs.

Modeling forest recreation in Baden-Wurttemberg, Germany

Matthias Wurster Forest Research Institute (FVA) Baden-Wurttemberg, Department of Forest and Society, Freiburg, Germany

In the German Federal Forest Act, the social demands towards forestry are recorded and depicted by forest function mapping. Since the last update of the recreation function in the federal state of Baden-Wurttemberg in 1988, the patterns behind public visits of forests for recreational purposes have constantly changed. To be able to model these changes on a regularly base in the future, the Forest Research Institute (FVA) of Baden-Wurttemberg started to develop its field of research activity "Forest Recreation" in 2008. On the base of a triangulation of qualitative and quantitative social research methodologies and GIS tools (e.g. ArcGIS extension Network Analyst), a network-based model has been generated to map the spatial distribution of forest visitors. The model incorporates service areas around settlements and forest entries as well as places of attraction and points of interest. The underlying parameters (e.g. time to forest, time in forest, attractiveness) are directly retrieved from representative inquiries about people's recreational activities and preferences throughout the state. In 2014/2015 the model's results will directly influence an imminent update of the recreation function in forest function mapping in Baden-Wurttemberg, Germany.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

An Ecological Effectiveness of Different Forest Management Regimes in an Anthropogenic Landscape in Bangladesh-Implications for Conservation

Mohammad Belal Uddin, Ph.D. Faculty Department of Forestry and Environmental Science Shahjalal University of Science and Technology Sylhet-3114, Bangladesh

Countless studies and numerous conceptual models have been developed on the landscape patterns of diversity in tropics. However, in recent years, widespread loss of old growth tropical forests has been identified by the ecologists and conservationists. This issue necessitates the assessment of ecological effectiveness of different management institutions in tropical forests with respect to different forest health measures. Therefore, recently, ecological researches have started to focus increasingly on the consequences of management regimes on forest health quality of ecosystems. Bangladesh, like other developing countries, burdened with huge population, is consistently changing the management institutions/regimes to conserve its last remaining natural resources in the forest ecosystems. Forest ecosystems in this human dominated landscape are in an unsustainable state due to over exploitation and resource depletion. Decentralized forest management (e.g. co-management) has been launched subsequently to achieve sustainable development and conservation related goals. However, ecological analyses of these management regimes are rare in Bangladesh. Therefore, the aim of this study was to assess the forest health quality under different management institutions. Digital elevation models, satellite images, systematic sampling, and circular plots were used to design potential sampling sites across different management regimes to answer this issue. Ground level ecological measures of forest health quality (i.e. species richness, abundance, basal area, canopy cover, regeneration, disturbances e.g. stump removal, lopping) across different management regimes were collected. Finally, all data were analyzed using R-statistical program to assess the ecological effectiveness of different management institutions with respect to the recorded measures. The result supported the proposition that management regimes have effects on ecological traits of forest health in the ecosystems. Most of the measures of forest health quality were found significantly satisfactory in co-managed (participatory) areas of forests. It was also found that co-managed areas attributed with lower number of anthropogenic disturbances than the other areas managed traditionally by the government. This assessed relationship in Bangladesh forest landscape will help forest managers and policy makers to design a proper conservation and management plan.

A Tangible Landscape Modeling Environment for the Collaborative Analysis of Invasive Species Spread

Francesco Tonini, Douglas Shoemaker - Center for Geospatial Analytics, NC State University; Vaclav Petras, Anna Petrasova -Marine, Earth, and Atmospheric Sciences (MEAS), NC State University; Ross K. Meentemeyer, Center for Geospatial Analytics, NC State

Preventing and responding to the substantial ecological, economic, and human welfare impacts from invasive species is a multifaceted challenge. High-resolution model predictions of how, where, and the speed at which an exotic species will spread across a heterogeneous landscape can greatly assist timely detection, quarantine, or eradication efforts. Success depends on integrating spatially-explicit dispersal simulation models, field-based measurements and surveillance, and realistic management options. Compared to a single visualization of model output on a computer screen, actively collaborating with local actors, decision makers, and resource managers in the modeling process may lead to a better understanding of the establishment and spread of an invasive species, as well as identification of effective control strategies. This integration can help policy-makers and regulatory agencies adapt to risks posed to target ecosystems. Tangible Landscape, a free and open source collaborative geospatial modeling environment, was used in this study as a 3D visualization tool to explore the landscape-level

spread of two different invasive species: (i) Phytophthora ramorum, a multihost plant pathogen and causal agent of sudden oak death (SOD), and (ii) Nasutitermes corniger (Motschulsky), a destructive termite species. The two case studies demonstrate how novel geospatial modeling and visualization techniques can spark collaboration and involve stakeholders to bridge the existing gap between science and decision makers.

Recent patterns of wildfire severity across a transboundary ecoregion of the United States-Mexico borderlands

Miguel Villarreal, US Geological Survey, Western Geographic Science Center; Citlali Cortes Montano, Centro Interdisciplinario de Investigacion para el Desarrollo Integral Regional Unidad Durango; Jakeb Prickett, US Bureau of Reclamation*

The mountain ranges in the Madrean ecoregion of the southwestern United States and northern Mexico have similar species assemblages and topographic characteristics, but have been managed in strikingly different ways since the mid-1800s. Differences in land use and forest management, particularly active wildfire suppression in the U.S. and lack thereof in Mexico, have led to contrasting fire regimes which may provide information to help guide forest restoration in the U.S. and inform Mexico's fire management plans. In the U.S., federal agencies developed the Monitoring Trends in Burn Severity (MTBS) national database of fire location and burn severity, however similar data for many remote areas outside of the U.S. are generally sparse. To help fill this data gap, we developed a semi-automated process to identify historical wildfire occurrence in Mexico using Landsat Thematic Mapper data time series from 1985-2011. We circumvented the need for a priori knowledge of fire occurrence by combining differenced Normalized Burn Ratio (dNBR) images covering sequential and overlapping seasonal blocks, identifying 83 large (> 1,000 acre) wildfires in northern Mexico during the period. We compared fire severity of these fires to fires in the U.S. using the dNBR and the relative dNBR and found increasing severity at high elevation forests in the U.S., but no similar trend in forests in Mexico. In contrast, savanna and woodland fires in both countries showed increases in severity over time. Fire years with numerous large burns were generally different across the border from 1985-1997, but became more synchronous from 1997-2011.

Concluding Remarks & Discussion with John A. Wiens

Jianguo (Jack) Liu, Helene H. Wagner and Nancy McIntyre

NULL

Do protected wetlands enhance the occurrence and abundance of anurans in the Brazilian Cerrado?

Katia A. Kopp, Federal University of Goias; Kimberly A. With, Kansas State University

Amphibians are known to be sensitive to human land-use practices that reduce and degrade wetland habitats. We therefore expected protected wetlands within the largest national park in the Brazilian Cerrado (Emas National Park) to have a positive effect on the occurrence and abundance of four anurans representative of the Cerrado. We adopted a multi-model information theoretic approach to assess whether the protection status of wetlands (either inside or outside the national park), as well as the amount of riverine and anthropic habitats in the surrounding landscape, affected a species' occurrence or abundance during two years of study. Although site occupancy was little affected by the protection status of these wetlands, species' abundances were actually found to be greater in wetlands outside the national park. Site occupancy was positively associated with the amount of riverine habitat in three species, whereas abundance was positively associated with the amount of riverine habitat in two of

these same species, in at least one year. A fourth species (Scinax fuscomarginatus) was the only one to exhibit a negative relationship with the amount of anthropic habitat, during the second year of study. Apparently, the high proportion of riverine habitats outside the park is helping to mitigate the effects of agricultural land use on these species, and underscores the value of maintaining natural habitats beyond reserve boundaries.

Operationalising the ecosystem services concept: symposium introduction

Marc J. Metzger, The University of Edinburgh

Like landscape ecology itself, the ecosystem services concept is seen by many as a useful paradigm to support decision-making at the complex interface between science, policy and practice. However, to be successful, it requires a strong willingness for collaboration and joint understanding. To support development of a European ecosystem services community of practice, the OPERAs and OpenNESS research collaborations are currently developing Oppla, a virtual meeting ground for ecosystem services tool users, providers, and researchers. This initiative, supported by 18 million Euro of European Commission funding, aims to empower European communities to improve natural resource management for human well-being, crossing scales, disciplines and borders. This presentation will introduce Oppla, and explain the symposium structure.

Recoupling agriculture with landscape and rural development. Including commercial farming development into collaborative landscape planning

JÃ¸rgen Primdahl, David Pears, Lone Kristensen, Andreas Aagaard -Department of Geoscience and Natural Resources Management, University of Copenhagen, Denmark; Esben Munk SÃ¸rensen, Department of Development and Planning, Aalborg University, Denmark

Historically Danish agricultural modernization, rural development and landscape change have been closely connected. Since the 1950s however Danish agricultural production has - parallel with a continuous increase in livestock density and productivity - been dramatically specialized and centralized and agriculture has gradually become de-linked with the local landscape - both in terms of production inputs and socially. During the same period the rural landscape has been increasingly affected by non-agricultural processes, first of all urbanization in various forms. Whereas recent experiences with collaborative landscape planning carried out in partnership between the local planning authority (the municipality) and the local community have shown high degrees of motivation among local citizens (including farmers) to constructively participate, farmers have not shown interest in bringing in the business dimensions of their farm into these processes. Involvement of farm businesses in collective landscape decision making are analyzed and discussed based on an ongoing planning experiment and on data from face to face interviews with all farm property owners in the area in question. Conditions for and perspectives of farm business involvement including property structure and prospects of farm consolidation, local traffic patterns, and habitat connectivity and management are analyzed and discussed in some detail.

Backcasting historic land-cover of the United States from 1938-1992

Ryan R. Reker, InuTeq; Kristi L. Sayler, US Geological Survey; Terry L. Sohl, US Geological Survey; Jordan Dornbierer, SGT Inc; Robert J. Quenzer, SGT Inc; Steve P. Wika, SGT Inc*

Land-use and land-cover (LULC) data can be an important component of ecosystem assessments yet spatially-explicit, regional-scale LULC is rarely available for historical periods. Recently, the U.S. Geological Survey completed a set of modeled historic LULC data for the conterminous U.S. The FORE-

SCE (FOREcasting SCEnarios of land-use change) model was used to create spatially-explicit, thematically-detailed annual LULC maps from 1938 to 1992. USGS Landcover Trends data provided EPA ecoregion-based information on rates and types of regional land change. County-level statistical data from U.S. Census of Agriculture provided information on local agricultural patterns throughout the simulation period. Historical USGS topographic maps and U.S. Census housing data were used to parameterize changes in localized urban extent. Proportions of overall historical change were determined from these and other historical data sources, while FORE-SCE produced spatially explicit projections using a patch-based allocation procedure. Distributions of modeled historical land cover were compared with multiple historic reference sources to assess model performance. This paper will present the methods, LULC modeling results, and validation metrics for the conterminous United States. Spatial data from this effort is freely available and accessible through the Land-cover Modeling at USGS Earth Resources Observation and Science Center website (http://landcover-modeling.cr.usgs.gov)

Joint Production Possibilities for Management of Multiple Wildlife Species, Carbon, and Wood Products in Pacific Northwest Forests

Anita T. Morzillo, University of Connecticut; Blair Csuti, Oregon State University; Keith Olsen, Oregon State University; Brenda McComb, Oregon State University; Mark E. Harmon, Oregon State University; Jeff Kline, US Forest Service; Rob Pabst, Oregon St*

Recent attention has focused on forest-based, broad-scale climate change mitigation strategies considering multiple ecosystem services. We evaluated tradeoffs among carbon, wildlife habitat, and wood products within a forested landscape of the Oregon West Cascades. We used the LANDCARB model to simulate dynamics of living and dead carbon pools and wood products. Outputs were linked to wildlife capability models to assess how different strategies for managing carbon interacted with habitat for seven wildlife species with contrasting habitat requirements. Forest management scenarios included varying rotations (25-250 years), harvest block sizes (10-500 ha), harvest utilization levels, and treatments of dead wood (salvage and snag felling). Plots of stable solutions indicated ranges of potential tradeoffs that were grouped by key management variables. Habitat responses for each species were assessed in terms of how treatments resulted in joint production possibilities for multiple species. Species pairings illustrated different inter-species relationships including complementarity and competition in habitat. For example, longer rotations resulted in more habitat for both marten and flycatchers, but distinctions emerged given different treatments of dead wood and harvest intensity. Conversely, mid-length rotations (50-75 years) led to more western bluebird habitat, but were not compatible for spotted owl without sufficient interspersed older-growth closed-canopy forest. However, treatments creating more owl habitat complemented that for red tree vole, a significant owl prey species. This information enables us to examine relationships between many forest ecosystem services of public value, and the degree to which production of one service is either compatible or incompatible with production of others.

Testing the correlations of avian biodiversity with habitat configuration and landscape heterogeneity on the Eastern Qinghai-Tibetan Plateau

Li Li, Chair of Wildlife Ecology and Management, Albert-Ludwigs-Universitat Freiburg; Andreas Fritz, Chair of Remote Sensing and Land Information Systems, Albert-Ludwigs-Universitat Freiburg Ilse Storch, Chair of Wildlife Ecology and Management, Albert-L*

The Qinghai-Tibetan Plateau is the worldâ€™s highest alpine ecosystem which shelters a rich diversity of native flora and fauna. While nomadic pastoralism largely shaped the landscape, a set of grassland management reformations were introduced. Since 1984 the state leased livestock and pastures to

individual households. In the 1990s nomads started installing barbed wire fences to designate private pasture boundaries. The landscape-scale consequences of these land-use changes were significant: privatized pastures and fences changed the grazing disturbance regime thus increased the landscape patchiness; meanwhile the added anthropogenic infrastructures enriched landscape heterogeneity. In this research we tested the hypothesis that habitat mosaics and the heterogeneous landscape maintain higher avian alpha-diversity. In 2014 we carried out breeding season bird survey in the study area Nyanpo Yutse of the eastern Plateau. To map landscape elements and habitat structure of the 140 sample plots, we used remotely piloted aircrafts to acquire high-resolution (10 cm) ortho-images which covered 45.8 kmÂ². The study showed that habitat diversity is positively correlated with bird richness, while anthropogenic elements only increased the number of generalists. Among different habitat configurations, homogenous degraded grassland patches had the lowest bird richness with the habitat dominated by White-rumped Snowfinch (Montifringilla taczanowskii).

Isotopic and elemental records reveal impacts of past faunal changes on nutrient and energy flow in grassland ecosystems

Kena Fox-Dobbs, University of Puget Sound*

Carbon and nitrogen stable isotopic and elemental compositions of modern and historical soils, plants, and animal tissues can provide insight into anthropogenic changes in nutrient and energy cycling in grassland ecosystems. The dynamics of these changes are often cryptic, and their legacies poorly constrained. I will discuss isotopic and elemental records collected from a Kenyan savanna, and the Northern Range grasslands of Yellowstone National Park. Both ecosystems have experienced large, human-mediated changes in mammalian faunal population sizes and distributions (wildlife and livestock). These changes influenced the distribution of resources across the landscape in the past and present. For example, the diets of historic and modern Kenyan grazers (Grevy's and plains zebras) vary depending upon presence of livestock. The relative proportions of grass versus non-grass vegetation in diet record patterns of forage availability. The history of areas of high density livestock occupancy are also recorded in the spatial patterns of soil and plant biogeochemistry. Historic Yellowstone faunal changes, namely the extirpation of grey wolves and large variations in population sizes of native grazers (elk and bison), influenced below and above ground nutrient dynamics. These case studies demonstrate how biogeochemical records reflect impacts of anthropogenic environmental changes on grassland ecosystems.

How valid are today's decisions in the future? Integration of ecosystem dynamics in reliable ES provisioning potential assessment

*Christine Furst *; Susanne Frank; Marcos Jimenez, University of Bonn, Center for Development Research*
Katrin Pietzsch; Frank Pietsch, PiSolution GmbH Markkleeberg

The mapping and assessment of ecosystem services is considered to be a highly relevant decision basis for environmental policies, in land use planning and in regional development. A critical aspect for supporting policies and decisions, however, consists in the fact that the provision of many ecosystem services underlies not only large spatial discrepancies, but is also highly variable over time. Taking particularly regulating and provisioning services as examples, these are greatly driven by the abundance, quality and quantity of the vegetation cover. No ideal reference point in time can be determined to define what the average provision of such a service is. By combining growth, yield and production models with the spatial assessment of ecosystem services provisioning potentials, intra-annual variability and critical spatio-temporal trends can be revealed much more precisely. With this presentation, we suggest how models operating at different spatial and temporal scales can be

combined. We will show some examples from embedding forest and agricultural models in the spatially and temporally explicit assessment of provisioning services. We will conclude on how to evolve a comprehensive modelling framework that respects also different data qualities and availabilities.

The Diversity of Approaches to Landscape Ecology and Landscape - in Europe and Beyond

Ingrid Sarlov Herlin, Department of Landscape Architecture, Planning and Management, Swedish University of Agricultural Sciences, Sweden

This paper discusses the diversity of approaches to 'landscape' and the application of landscape ecology, in the member states of Council of Europe i.e. the countries that can join the European Landscape Convention (ELC). The study discusses the implications of the diversity approaches to landscape, not at least reinforced by differences of landscape notion in different languages, and different approaches to planning, management and protection. The different meaning of 'landscape' may not only influence how values are shaped differently in the different countries but also create communication gaps in the implementation of the ELC and in the international landscape ecology discourse. The ELC supports that 'landscape' should be understood in the specific contexts, shared by the people concerned. Implementation of the ELC hence comprises a different challenge than implementation of environmental policies and EU directives, handling less elusive and less context depending concepts; such as corridors, habitats or species, implemented through a top-down approach by experts. Also landscape ecology has its different interpretations and applications; between for example the European more holistic perspective, aiming to integrate nature and culture, and the North American based 'school' of landscape ecology derived mainly from spatial ecology. More recently, outside Europe, the notion of a landscape approach is also increasingly used for sustainable agriculture and forestry in tropical countries, merging the scale thinking from landscape ecology with a unifying landscape concept signifying democratic processes (as in the ELC). The paper concludes that more work is needed in order to unearth the landscape concept and make it understood across over differing disciplines and across linguistic borders. International organizations such as IALE have an important role for this.

Summary and Discussion

Matthias Burgi, Swiss Federal Research Institute WSL

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Development of a spatially explicit, multi-stakeholder tool to assess ecosystem services

Cara A. Campbell, United States Geological Survey, Northern Appalachian Research Laboratory; Daniel E. Spooner, United States Geological Survey, Northern Appalachian Research Laboratory*

Human alterations to landscapes and ecological processes complicate balancing the needs of multiple stakeholders. Ecosystem service valuation has the potential to facilitate policies that couple communities to their much needed natural capital (clean and abundant water). While many acknowledge the importance of freshwater from a socio-economic perspective, few characterize benefits arising from nutrient cycling. Interestingly, nutrients simultaneously serve as key nutritional subsidies (physiology) and environmental contaminants (eutrophication). By extension, nutrients represent a common thread linking environmental and socio-economic issues. Here we embrace this link to develop a spatially explicit tool that incorporates multi-stakeholder objectives (biodiversity, ecosystem services, and nutrient management). Species distribution models provide metrics of habitat suitability for key species of interest and biodiversity. Furthermore, we use SPAtially Referenced Regressions On Watershed attributes (SPARROW) derived predictions of nutrient sequestration as

metrics of ecosystem functioning, and wastewater treatment plant budgets to assess the costs of ameliorating nutrients. Our metrics of habitat suitability and biodiversity, ecosystem functions (nutrient removal), and economic valuations are now incorporated into a spatially explicit, science-based tool, that addresses multi-stakeholder issues and prioritizes sites of restoration and conservation potential. Once completed, the functionality and concepts will be expanded to other ecosystem service metrics in different regions and ecosystems impacted by human activities.

Integrated ecosystem assessment and co-management of socio-ecological production landscapes

Osamu Saito, Chiho Kamiyama, Nick Landreth, Yaw Agyeman Boafo, Moses Hillary Akuno, Kazuhiko Takeuchi - United Nations University (UNU)*

Satoyama-satoumi' is a Japanese term for socio-ecological production landscapes and seascapes (SEPLS). They are characterized by a dynamic mosaic of different ecosystem types which maintain higher biodiversity and produce a bundle of ecosystem services. Our study applied the latest conceptual framework developed by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) to local ecosystem assessments and co-management of socio-ecological production landscapes in Asia and Africa. One of the unique characteristics of SEPLS is sharing provisioning services within and beyond communities, such as forest, agricultural and marine products. Conventional ecosystem assessments based on statistical data often ignore the benefits of these non-market provisioning services. Using household questionnaire surveys and online web survey, we investigated the benefits of sharing good and services provided from SEPLS. In rural Japan, sharing various provisioning services significantly contributes to human well-being, and such sharing networks often play a central role for maintaining traditional culture. In rural northern Ghana, the application of diverse forms of traditional values and beliefs for resource management reinforces existing sharing networks because of strong relational and communal ties, while in rural Indonesia, Jogjakarta province, the traditional sharing of provisioning services and reciprocal communal labor plays a big but normally under the radar in managing natural resources. Our surveys also suggested urbanization and globalization in recent decades have weakened community connections and sharing mechanisms. These assessments demonstrate how encouraging sharing and co-management of ecosystem services can strengthen localized models of sustainable societies in harmony with nature.

An evolutionary demogenetics simulation framework: linking genotype-environmental effects to evolutionary processes through movement and natural selection.

Erin Landguth, University of Montana; Andrew Bearlin, Seattle City Light*

Combining population viability analysis with landscape genetics models offers a powerful approach for addressing questions for eco-evolutionary applications, while linking directly to conservation genetics and management. We present CDmetaPOP, a program to simulate changes in genotypes through time as functions of individual-based movement and complex population dynamics through multiple and changing landscape drivers. The software provides functionality for a wide variety of modelling applications ranging from applied questions, where it can be parameterized for real landscapes and species to compare alternative potential management interventions, to purely theoretical studies of species' eco-evolutionary dynamics and responses to different environmental pressures. We created a system model for westslope cutthroat trout in the Sullivan watershed riverscape in NE Washington State to explore how climate change can effectively isolate populations by changing thermal or hydrologic regimes in different regions of the river network used by fish during different seasons. We warmed high elevation streams and ask how quickly alleles for thermal tolerance "invade" these areas. Similarly, we asked how alleles for earlier spawning and migration tied to changes in thermal and hydrologic regimes

alter demographics in headwater streams. Simulations evaluated the resultant patterns of demogenetic viability in westslope cutthroat populations over time and showed areas where adaptive alleles could not spread fast enough to keep up with warming. Then through simulations, we translocated appropriate numbers of fish carrying the adaptive alleles into populations suffering high temperatures in order to stabilize declines and improve demogenetic outcomes.

Landscape-level evaluation of ecosystem services: Urban, plantation, and natural forests in the central part of Japan

Makoto Ooba, National Institute for Environmental Studies

Forest ecosystems cover approximately 68% of the total land surface of Japan. However Japanese plantation forests are not managed well and forests in urban areas decreased due to development. Degradation of forest ecosystems was caused. Landscape-level evaluation of ecosystem services was carried out: the forest ecosystem model (BGC-ES) to estimate supporting, regulation and provisioning services simulated biogeochemical cycle. Biodiversity was evaluated by a habitat suitability model for mammal species. Cultural services were estimated by a questionary investigation. Using the system, important and critical ecosystems were identified on the geographical maps of the research area. The importance of continuity of ecosystems, especially in urban areas, was stressed upon in the context of wildlife conservation. This methodology is useful for evaluating ecosystems in landscape planning.

Interfaces between landscape structure and ecosystems services

Jean Paul Metzger, University of Sao Paulo, Brazil; Elizabeth Nichols, Swarthmore College, US

The objective of this presentation is to introduce a conceptual framework that allows to link landscape structure, ecological processes, biodiversity and biodiversity-mediated ecosystem services. The spatial scale of existing ecosystem service regulation studies are predominantly local (e.g. via experimental manipulations), or rather global (e.g. via correlative, proxy-based mapping). Consequently, there is a knowledge gap at the intermediate scale of landscape - a scale that permits the quantification of regulatory mechanisms with enhanced precision, while enabling the extrapolation of results across spatial scales and system boundaries. Recent work that targets this knowledge gap has permitted a preliminary assessment of the distinct ecological processes that mechanistically link landscape structure and ecosystem services, including edge effects, spillover processes, habitat complementation and supplementation effects, and connectivity of species that provide ecosystem services. Characterizing these links is a particularly important step in the planning of multifunctional tropical landscapes that ensure the simultaneous maintenance of original biological diversity, multiple ecosystem functions, and agricultural production. We will explore how habitat loss influences ecosystem services, and specifically investigate the likelihood of thresholds and trade-offs in service provision. We intend to provide: (i) a strong overview of the state of the science for different ecosystem services; and (iii) an integration of the different approaches of ecosystem services research, tied together within the landscape perspective.

Ecosystem Services Across International Borders: Data Needs and Modeling Approaches

Laura Lopez-Hoffman, School of Natural Resources and Environment, Udall Center for Studies in Public Policy, University of Arizona; Robert Varady, Udall Center for Studies in Public Policy, University of Arizona*

International political borders rarely coincide with natural ecological boundaries. Because neighboring countries often share ecosystems, watercourses and species, they also share ecosystem services. For

example, the United States and Mexico share the provisioning service of groundwater; the regulating service of crop pest control services by Mexican free-tailed bats; and the aesthetic value of the North American monarch butterfly, a cultural service. We suggest that the concept of ecosystem services could be used as an organizing principle for transborder conservation, because it meets many of the criteria for successful transborder policy. It would frame conservation in terms of mutual interests between countries, consider a diversity of stakeholders, and provide a means for linking multiple services and assessing tradeoffs between uses of services. We conclude by discussing the modeling approaches and data needs for using ecosystem services to frame the transborder governance of ecosystem services provided by shared waterways and species.

Recap from Morning Session

Sadahisa Kato, Ibaraki University

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The principle of optimum biodiversity as a theoretical approach to the assessment of biodiversity and ecosystem services in the landscape

Bukvareva Elena, A.N. Severtsov Institute of ecology and evolution Russian academy of sciences, Biodiversity Conservation Center, Moscow

The principle of optimum diversity of biosystems suggests that biodiversity is an adaptation of biosystems to environmental conditions and it is a parameter to be optimized. Biosystems with the optimal diversity have maximum efficiency, probability of survival and have the largest volume of ecosystem functions. Diversity is considered at two hierarchical levels - population (phenotypic diversity within a population) and coenotic (species number in a community). The optimum values of diversity emerge during interaction of these hierarchical levels and depend on the amount of available resource, the degree of environmental stability and the evolutionary level of organisms. The optimum values of species diversity increase in more stable and "rich" environments, while the optimum values of intrapopulation diversity decrease in more stable environments and are independent of the resource amount. Human disturbance of populations, communities and the environment pushes biosystems away from the optimal values of diversity and thus weakens their ecosystem functions. Landscape is a combination of habitats with different amount of resources and different instability which are disturbed by people in different degree. All these factors determine the mosaic of the biosystems characteristics: the optimum values of diversity, the degree of deviation from the optimal state and the rate of degradation of ecosystem functions.

Annual carbon budget from deforestation, fragmentation and regrowth in Southeastern Amazon

Leticia Hissa, Geography Department and Integrative Research Institute on Transformations of Human-Environment Systems - Humboldt Universitat zu Berlin; Hannes Muller, Geography Department - Humboldt Universitat zu Berlin; Ana Paula Dutra Aguiar, Earth S*

Within the global climate change debates carbon emissions driven by land use and cover change in tropical areas have been subject of high scientific and political interest. It is particularly the assessment of changes in aboveground carbon stocks associated with clear-cutting deforestation that have been studied. The aim of this study is to augment existing assessments by modeling above and belowground carbon storage, addressing deforestation, fragmentation and regrowth. We chose the BR-163 transportation corridor, in Para and Mato Grosso, Brazil, as a study case, one of the Amazonia's regional hotspots of deforestation and forest degradation. To estimate carbon losses and uptake we used novel

Landsat-based annual deforestation maps covering the period from 1984 to 2012. We applied INPE-EM, a spatial modeling framework for carbon balance assessments from deforestation and uptake from regrowth. To explicitly address fragmentation we modified the INPE-EM model by a module to investigate the relative importance of forest fragmentation leading to edge biomass collapse on the carbon balance. We identified that emissions from edge biomass collapse represent a small share of clear cut deforestation emissions, but with increasing importance due to the advance of forest fragmentation across our study area. Regrowth uptake offsets a small portion of total emissions, showing little and decreasing importance due to high turnover rates and land intensification, respectively.

Integration of climatic water deficit and fine-scale physiography in process-based modeling of forest landscape dynamics

Jian Yang, University of Kentucky; Peter Weisberg, University of Nevada, Reno; Thomas Dilts, University of Nevada, Reno*

Climate warming can lead to large-scale drought-induced tree mortality events and greatly affect forest landscape resilience. Climatic water deficit (CWD) and its physiographic variations provide a key mechanism in driving landscape dynamics in response to climate change. Although CWD has been successfully applied in niche-based species distribution models, its application in process-based forest landscape models is still scarce. Here we present a framework incorporating fine-scale influence of terrain on ecohydrology in modeling forest landscape dynamics. We integrated CWD with a forest landscape succession and disturbance model (LANDIS-II) to evaluate how tree species distribution might shift in response to different climate-fire scenarios across an elevation-aspect gradient in a semi-arid montane landscape of northeastern Nevada, USA. Our simulations indicated that drought-intolerant tree species such as quaking aspen could experience greatly reduced distributions in the more arid portions of their existing ranges due to water stress limitations under future climate warming scenarios. However, even at the most xeric portions of its range, aspen is likely to persist in certain environmental settings due to unique and often fine-scale combinations of resource availability, species interactions and disturbance regime. The modeling approach presented here allowed identification of these refugia. In addition, this approach helped quantify how the direction and magnitude of fire influences on species distribution would vary across topoclimatic gradients, as well as furthers our understanding on the role of environmental conditions, fire, and inter-specific competition in shaping potential responses of species distributions to climate change.

Evolution of Forest Landscape Management in North America

Robert Coulson, Maria Tchakerian - Knowledge Engineering Laboratory, Department of Entomology, Texas A&M University

The concept of forest landscape management in North American forests evolved through a series of steps that reflect a change in the ethics of landscape use, technological advances, and the development landscape ecological concepts. Our goal in this paper is to examine this evolutionary pathway. As a preface we frame the discussion by defining a concept of forest landscape management that includes consideration purpose of management, the spatial unit(s) being managed, the type of forest being managed, and the proposed outcome of management. Next we trace the objectively verifiable change in the ethics of forest landscape-use management by examining the different models of forest management that have been applied in the US over the past 150 years. The final model in the sequence centers on forest landscape management and includes contemporary, but evolving, concepts relating to ecosystem/landscape services, forest landscape design, cultural landscapes, sustainability and stability

of forest landscapes, etc. We conclude with a discussion of where landscape ecology concepts are having demonstrable effects of forest landscape management.

OPERAs exemplars on Our Ecosystem - a web platform for publishing, sharing and managing spatial data

Karin M Viergever, Ecometrica*

Ecometrica's programming team and analysts have developed Our Ecosystem (OE), a web platform that makes it easy for users to access, organise, share, query and analyse spatial data on land cover and ecosystem services without requiring specialist GIS or remote sensing expertise. It provides practical and insightful advice to end users, including stakeholders, policy makers, industry groups and the general public, for example through providing access to and analysis of expert spatial data layers; mapping and quantification of resources, impacts and opportunities; showing or checking compliance to environmental legislation; and monitoring changes to natural resources. Several OPERAs exemplar studies use OE as a tool to communicate their data and results to collaborators, stakeholders and other end users. This presentation will demonstrate the OE platform as used by selected OPERAs exemplar studies. An explanation will be given of the OE platform, with emphasis on its various application fields for mapping and modelling Ecosystem Services and Natural Capital. Current developments for collaborative data storage and curation functionality will also be discussed. Researchers and other organisations that would like to share data layers that they have produced are encouraged to use the Our Ecosystem platform as a means to publish their data.

Alpine summer farming in Switzerland: Marginal grasslands between abandonment and intensification

Felix Herzog, Agroscope; Irmi Seidl, Swiss Federal Institute for Forest, Snow and Landscape Research WSL; Rosa Boeni, Swiss Federal Institute for Forest, Snow and Landscape Research WSL; Stefan Lauber, Swiss Federal Institute for Forest, Snow and Landscap

Alpine summer pastures - the seasonally used mountain grasslands between the tree line and unproductive rock and ice - are a distinctive feature of the cultural landscape of many European countries. In Switzerland, they make up one third of the agriculturally used land. The inter- and transdisciplinary research programme AlpFUTUR (www.alpfutur.ch), investigated past and future land use and related ecosystem service demand and provision of the summer pasture regions. AlpFUTUR consisted of 22 disciplinary projects (agronomy, ecology, economy, food science, history, sociology), which were co-ordinated towards an overall synthesis. Key findings comprise: 1) There is a high societal demand for services provided by summer farming, which is reflected by support from policy. 2) Partial abandonment of summer pastures will continue. If it is targeted towards hazardous and remote areas, this may contribute to the overall economic viability of summer farms whilst providing benefits for biodiversity. 3) Climate change may increase the attractiveness of summer farming in the future due to longer vegetation periods and comparatively less drought than in lowland agriculture. 4) Engaging skilled and motivated herders will remain a key challenge for the maintenance of summer farms. Although summer farming is deeply rooted in traditions, it has evolved over time and will continue to do so. AlpFUTUR results are communicated in a synthesis book, in a documentary film and in three short movies, addressing professionals, the public at large and herders, respectively.

Linking ecological processes with the capacities of ecosystems to provide services

*Christine Furst, Susanne Frank * - University of Bonn, Center for Development Research (ZEF); Katrin Pietzsch, Frank Pietzsch - PiSolution GmbH Markkleeberg*

Ensuring the provision of ecosystem services (ES) to society is one of the key challenges of sustainable land management. An important question consists in how to integrate knowledge on various temporal and spatial scales and their interactions. From complex system research, phenomena such as emergence effects are researched for basic ecological processes. However, they are not well integrated when it comes to socio-ecological interactions and their relevance for the capacities of ecosystems to provide services at the level of request. In the EU project RegioPower, we combined micro- and mesoscale models for the provision of ligno-cellulosic biomass with instruments for analysing spatially explicit requests. Aim of the project was to develop a highly integrative platform that moderates between demands and needs and builds time series on how these vary as basis for adaptation strategies in regional land management. We introduce the RegioPower platform and focus on how to improve the integrated assessment of temporal and spatial fluctuations in ecosystem services provisioning capacities using the GISCAME software. We conclude on how to further develop the platform and make it operable for regional and particularly rural development.

Closing Disussion

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Landscape change of vegetation in the alpine tundra of Changbai Mountains, Northeast China

Wu Zhengfang, Northease Normal University; Zong Shengwei, Northease Normal University; Du Haibo, Northease Normal University.

The vegetation of alpine tundra in the Changbai Mountains has experienced great changes at the landscape scale. Currently, mountain birch at the tree line position showed upward shift trend to the alpine tundra, which lead to the shrink of the tundra on the north slope, whilst migration of Deyeuxia angustifolia, a herb grass, from mountain birch forest to the alpine tundra lead to the meadowization of tundra on the west slope. Prediction on the tree line position was applied by combing topographic variables. We hypothesized that topographic controls were responsible for causing the variations in the tree locations. To test the hypothesis, we used IKONOS images and WorldView-1 image to identify the tree (mountain birch) locations and developed a logistic regression model using topographical variables to identify the dominant controls of the tree locations. The results showed that aspect, wetness, and slope were dominant controls for tree locations on western side of the mountains, whereas altitude, SPI (snow potential index), and aspect were the dominant factors on northern side. The upmost altitude a tree can currently reach was 2140 m asl on the northern side and 2060 m asl on western side. The model predicted results showed that habitats above the current tree line on the both sides were available for trees. We also investigated the migration process of D. angustifolia and described the impacts of migration on the alpine vegetation on landscape and community scale. Through the comparison with the historical survey data, it was found that D. angustifolia had successfully established in the tundra zone and formed plant communities. The migration of D. angustifolia started in the late 1980s. Since the year of 2000, D. angustifolia gradually replaced Rhododendron chrysanthum, the native plant, and become dominant. In conclusion, upward migration of plants would lead to the changes in structure and function of the alpine tundra.

How to deal with cross-scale interactions in planning ecological networks?

Julie Chaurand, Irstea Montpellier; Jean-Philippe Tonneau, CIRAD Montpellier; Jacques Baudry, INRA Rennes*

A key measure of the "Grenelle Environnement" (open multi-party debate in 2007 to tackle the environmental issue), the "Trame verte et bleue" (TVB) was established in the French law. TVB aims at preserving and restoring ecological networks and is implemented at different spatial and governance scales, from national to regional and to local. Regions are presently designing or finalizing their regional ecological network scheme (SRCE) which will have to consider national orientations and will need to be addressed in the municipal and inter-municipal planning documents (in particular urban documents among others). Cross-border coherence is also integrated into the law. Some difficulties appear when actors try to articulate projects between scales, namely because of: cross-scales inconsistencies in knowledge, variety of methods, complicated terminology, different stage of progress in planning, issues and stakeholders' influence on territories, naturalist vision versus multi-functional vision, vagueness and weakness in the French law about "taking into account" other documents, problems to aggregate or disaggregate maps, etc. Our PhD. thesis question is: what are the conditions which ensure the environmental coherence of ecological networks between these different land management scales? Our work is based on observations and interventions on case studies in two French regions (Languedoc-Roussillon in the south and Bretagne in the west). The thesis, in particular, aims at specifying possible sources of inconsistencies, incompatibilities and/or uncertainties between the TVB policy plans identified at different scales; and at proposing ways to improve the inter and intra-scales articulation of these plans. Our poster will present our hypotheses and first analysis and propositions.

Exploring eye-tracking as an innovative tool for landscape planning

Lien Dupont, Ghent University; Veerle Van Eetvelde, Ghent University*

Landscape planning, which focuses on the management of existing landscapes and the creation of new landscapes, not only affects the functioning of the ecosystems, it also alters the visual aspects of the landscape. Often, planned landscape changes and new developments are evaluated beforehand using landscape visualizations in which the plans are simulated. Besides querying how the adapted or newly created features of a landscape are evaluated, visualizations can also be used to determine how changes in a landscape are visually perceived. This is often not considered sufficiently, while it is an important part of the planning process, as landscape management and planning are inextricably linked to perception. A relatively novel technology which allows to objectively measure how landscapes are observed is eye-tracking. By registering an observer's point of regard as well as the eye movements made while viewing landscape visualizations, it is possible to identify which (new) features in a landscape catch the attention and which do not. Questionnaires can be used to gain insight as to why this is the case. This combination offers broad perspectives to evaluate the visual impact of new landscape developments. The results of eye-tracking experiments can be statistically analyzed and visualized using heat maps. This paper presents an overview of the application of eye-tracking in landscape perception research so far. The question is raised how this technique could offer solutions for evaluating visual aspects in landscape planning processes and environmental impact assessments.

Mapping Land-cover change with 1-m NAIP data across the 35,000 km2 of the Puget Sound, WA ecosystem for management and science

Kenneth B. Pierce Jr. Jeanne Miller, Kevin Samson, Timothy Quinn; WDFW Habitat Science Division*

While high resolution aerial imagery is becoming increasingly available, drawing meaningful data from it is still a computationally difficult task. We have developed an Object-Based Image Analysis change detection program geared towards measuring canopy loss and impervious surface increase using 1-m aerial imagery. High resolution change data is important for capturing the typical small changes

occurring throughout urbanizing areas. To date we have completed two change periods, 2006-2009 and 2009-2011 and have mapped over 91,000 change locations. These changes cover over 663 km2 with a median change size of 1/20 hectare or about Â½ of a single Landsat pixel. Each change location has been reviewed by an analyst and attributed with the percentage of overall change, canopy loss, impervious surface increase (buildings, roads, etc.), semipervious surface increase (grading, gravel, soil compaction by vehicles, etc.), initial land cover and cause of the change. These data are intended to provide broad extent, high accuracy change data to assess land cover change, critical area ordinance effectiveness, regional planning effectiveness, assess habitat fragmentation through time and provide input to watershed, landscape and regional change models. These data can also provide contextual information for modeling land-use impacts on water quality, storm water issues and fragmentation effects on species as well as riparian change rates and contrasts among different types of ownership and zoning. A brief overview of the methods will be presented along with summary information about regional trends in the Puget Sound basin. A third period, 2011-2013 will be available in early 2016.

Culture in Contemporary Landscape Ecology for the New Millennium

Veerle Van Eetvelde, Department of Geography - Ghent University, Belgium; Dieter Baeyens, Department of Geography - Ghent University, Belgium; Isabel Loupa Ramos, Instituto Superior Tecnico - University of Lisbon, Portugal*

Current landscapes across the world are the result of the interaction between natural processes and human activities through times. Natural processes and human interaction created the basic landscape diversity, which is remodelled accordingly by societal needs. Since this relation is an intrinsic quality of landscape, it goes without saying that the cultural dimension of landscape should be addressed within the discipline of landscape ecology. This plea is already debated in landscape ecology literature, but a complete overview of the current state of the art is absent. This paper aims to give an overview of how culture is addressed in landscape ecology by reviewing the published papers in the journal of Landscape Ecology (since 2000). Based on the title, keywords, and abstract, papers will be selected for a more in-depth analysis how culture is addressed. The assessment consists of three sections. The first section will set out the origin of the authors (discipline, countries/regions, co-authors) to create sociograms of their interconnections. Secondly, the conceptual models, research approaches, and methodologies will be listed and compared. In the third part, the different categories of the content of the paper will be discussed, for example the degree of transdisciplinarity, dialogue between natural and cultural aspects, fundamental or applied research, among others. The paper will capture the diversity and understanding the trends in the current landscape ecological research in order to stimulate a cross-fertilisation of conceptual ideas and methodological approaches when dealing with the cultural dimension in landscape ecology.

Who perceives what and where? Results of facilitated workshops on spatial distribution of ecosystem services with nature conservation experts and lay people.

Agata Pietrzyk-KaszyÅ„ska, Institute of Nature Conservation Polish Academy of Sciences; Agnieszka OlszaÅ„ska, Institute of Nature Conservation Polish Academy of Sciences; Marcin RechciÅ„ski, Institute of Geography and Spatial Management Jagiellonian Univ*

Different perception of landscape and ecosystems is one of the important factors determining cooperation and participatory processes both in nature conservation and spatial planning. In the presented study we investigated spatial distribution of ecosystem services perceived in protected and adjacent non-protected areas by two groups: conservation professionals and local land users. The former group consisted of people professionally involved in spatial planning or nature conservation

(experts) and the latter of leaders of local communities (lay people). We selected five case study areas in Poland, that were different in size, shape, land cover, habitat structure and socio-economic characteristics. At each study site we conducted two facilitated workshops - one with the experts, one with the lay people - aiming at creating one map which reflected participants' agreement on ecosystem services distribution. Participants were asked to select perceived ecosystem services from a predefined list of ca. 20 services inspired by the CICES classification, and subsequently to assign given service with a spatial reference on a map. To facilitate the process, participants were guided by particular questions and provided with a basemap with predefined polygons based on natural habitats distribution and land cover. Using GIS software, we measured spatial overlays of various ecosystem services. We discuss the convergence and divergence between the two groups of stakeholders as well as frequencies of ecosystem services of different categories assigned to protected and non-protected areas. We shed light on particular challenges in participatory spatial management stemming from different understanding and perception of space and geographically referenced ecosystem services.

Donkeys, Debt, and Fire: The Rise of Industrial Capitalism and the Transformation of the Forest Ecology of the Pacific Northwest

Greg Gordon, PhD Gonzaga University*

Wildfires in the western United States have increased dramatically in both size and frequency since the late 19th century and are now arguably outside the range of historical variability. Forest ecologists have long implicated misguided fire suppression policies as creating a fuel build up that exceeded historical conditions. More recently, climate scientists note the high correlation between drought and forest fires and point to anthropogenic climate change as the driving force behind contemporary catastrophic wildfires. While drought and fire suppression certainly contribute to wildfires, especially in "fire-prone landscapes," an examination of the history of logging in Oregon's Coast Range, where wildfires are rare and "episodic," suggests that the current lack of ecological resiliency with regards to wildfire is a also a product of the transformation of American capitalism and the shift from proprietary to corporate structures that occurred between 1890-1920. Capital intensive technologies combined with changes in business organizational structures created the economic imperative for widespread clearcutting, which in turn, dramatically changed the composition, structure, and function of the forests of the Pacific Northwest. Using the Oregon Coast Range as a case study, this paper reviews historic and contemporary scientific literature, lumber company records, and economic history to trace the line of causality between technology, finance capital, timber industry practices, government policy, and catastrophic wildfire.

Symposium Opening Remarks

Ji Han, East China Normal University*

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Legacies of a century of land use in a biodiversity-rich traditional landscape in Transylvania

Patrick D. Culbert, Humboldt-Universitat zu Berlin; Jacqueline Loos, Leuphana Universitat Luneburg; Ine Dorresteijn, Leuphana Universitat Luneburg; Murray Clayton, University of Wisconsin-Madison; Joern Fischer, Leuphana Universitat Luneburg; Tobias Kuem*

The ecological impacts of past land use can persist for centuries. While land use in the era of satellite imagery is easy to quantify, characterizing historical land uses, and thus their impacts on biodiversity, remains challenging. Southern Transylvania in central Romania is a unique, biodiversity-rich area with a

long land-use history. Romania has undergone dramatic political and socio-economic changes, from the Austro-Hungarian Empire to two World Wars, communist dictatorship, capitalist democracy, and accession to the EU â€“ and these events have led to various land-use changes. Here, we investigated the effects of historical land use on present-day biotic community composition. We surveyed plants, butterflies, and birds at 150 sites and classified those sites as forest, arable land, or grassland using historical maps from the 1870s, 1930s, and 1970s, and satellite imagery from 1985, 2000, and 2012. We clustered sites based on community similarity to determine if present day plant, butterfly, and bird community composition is associated with land-use history. We found significant differences ($p = 0.030$) in bird communities between permanent forest sites versus forest sites that were non-forest in at least one study epoch. Bird communities in present-day grassland sites were also significantly different ($p = 0.050$) between permanent grassland sites and sites that were non-grassland (typically arable) in at least one epoch. Our findings emphasize the importance of taking a historical perspective when trying to understand current biodiversity patterns.

Simulating feedbacks among climate, vegetation, and fire in the expanding wildland urban interface

Zhihua Liu, Geospatial Sciences Center of Excellence, South Dakota State University; Michael C Wimberly, Geospatial Sciences Center of Excellence, South Dakota State University; Terry L. Sohl, Earth Resources Observation and Science (EROS) Center, U.S.;*

Wildfire risk within and around the wildland urban interface (WUI) is a central concern in fire-prone landscapes of the western United States. The WUI is a prototypical coupled human and natural system, and wildfire occurrence in the WUI reflects the influences of climate change, vegetation dynamics, and fire management combined with the continual growth of the WUI. Here we used the Coupled Human and Natural Geospatial Environments (CHANGE) model to assess how these drivers and their feedbacks affect WUI fire risk in the Colorado Front Range. The CHANGE model simulates landscape dynamics that arise from the interactions among land use change (including WUI growth), vegetation succession, and fire occurrence along with their feedbacks. Scenarios from a factorial design were simulated with different levels of (1) WUI growth, (2) climate-driven fire regime change and (3) climate-driven vegetation shifts. Patterns and trends in burned are and severity within and around WUI were compared among these scenarios. An ANOVA analysis indicated that all three drivers influenced burned area and severity in the WUI. Significant interactions were also detected, demonstrating that positive and negative feedbacks among climate change, land use change, forest succession, and fire also influenced the characteristics of the resulting fire regime. Our finding underscores the need to include more human-natural interactions in landscape models and to further develop a process-based foundation for the algorithms used to model these interactions.

Modelling future forest cover change in the Swiss Alps and the Polish Carpathians: drivers and implications

Katarzyna Ostapowicz, Department of GIS, Cartography and Remote Sensing, Institute of Geography and Spatial Management, Jagiellonian University, Poland; Bronwyn Price, Janine Bolliger, Urs Gimmi - Landscape Dynamics Unit, Swiss Federal Research Institute W

Forest cover expansion has been observed in developed countries since the 19th century, particularly in mountainous regions. The underlying drivers of forest cover change relate to climate and social and economic development leading to a decline of agricultural profitability associated rural population decline, agricultural land abandonment and subsequent conversion to forest particularly in the least valuable, marginal areas, such as mountainous areas. In addition, land management policies, including those aiming for forest conservation, typically result in the conversion of open land into forested areas.

In this study we model future forest cover change in two mountainous areas with similar biogeographic conditions but vastly different socio-economic histories, the Swiss Alps and the Polish Carpathians. Storylines for socio-economic development scenarios are derived along two axes of globalisation to regionalisation and market-driven development to high levels of policy intervention. Using the Dyna-CLUE land use modelling framework we model scenarios of forest cover change for 2065 in the two regions from the basis of the above storylines in combination with climate change projections. We compare the future forest cover change and variation in the importance of different drivers between the two regions and discuss implications of these changes on landscape and ecosystem services.

Integrating landscape assessments and gender variables with sustainable development initiatives in Uganda

Jane Bemigisha, ESIPPS International Ltd.

In a 1972 Stokholm UN General Assembly on Human Environment, a decision on Environmental Assessment committed the global community to facilitate the development of social and cultural indicators, among others. The decision was catalysed by the development of the UNEP flagship environment assessment process, the Global Environment Outlook (GEO). The UNEP GEO applies integrated environmental assessment (IEA) to develop policy relevant recommendations about the state of the environment and its inter-action with human development. At national level, countries are adopting the key IEA domains along human society and the environment indicator-based variables, that is, Drivers, Pressures, State and Trends, Impacts and Responses (DPSIR). There are, however, challenges in integrating gender variables, which are particularly relevant in the assessment of drivers and response aspects such as human and social capitals; population demographics; economic processes (production, consumption, markets and trade); and cultural, social, political and institutional processes as they apply to sustainable human development. In this paper, selected spatial indicators of DPSIR for gender that have been identified for Uganda are discussed in light of challenges, especially spatial gender data availability and integration with sustainable development. The indicators may be applied across African countries with similar landscape and social-economic characteristics.

Conservation landscapes: integrating terrestrial and aquatic habitats

Alex Fremier ,School of Environment and Management ,Washington State University Pullman Washingto; J. Michael Scott Department of Fish and Wildlife Sciences , University of Idaho, Moscow, Idaho

Conservation landscapes: integrating terrestrial and aquatic habitats Alex Fremier Washington State University and J. Michael Scott University of Idaho A crucial disconnect exists between the static nature of the United States' 19th century conservation infrastructure (e.g., protected areas) and the impacts of 21st century stressors, such as habitat loss and fragmentation, climate change, and invasive species. Connectivity is a valuable element for building ecological resilience into existing protected areas, but creating terrestrial connectivity by designing individual migration corridors is arguably untenable at a national scale. We explore the potential for a Riparian Connectivity Network (RCN) as a potential contributor to a more resilient conservation infrastructure at a national scale. The conservation value of riparian areas, is in their habitat, potential to network habitats and their ecosystem services. The results of our spatial analysis suggest that terrestrial protected areas are well connected through a stream network that is already protected at a higher rate than terrestrial lands and that the existing pattern of conservation easements augments this protection. We argue that (1) the spatial backbone for an RCN is already in place and (2) existing policies already favor riparian area protection. Pieces of an RCN are emerging from current conservation and restoration actions and as a result of existing governance

requirements and incentives. With focused attention, increased institutional collaboration, and improved incentives, these pieces can continue to coalesce and become an integral piece of a comprehensive conservation infrastructure.

Partitioning plant diversity in planted forests of Beijing China: A hierachical multiscale analysis

Yuxin Zhang, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences; Shuang Zhang,Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences; Keming Ma, Research Center for Eco-Environmental Sciences, Chinese Academy*

The role of planted forests in conserving biodiversity is gaining more attention. Previous work finds that the impact of forest plantations on biodiversity depends on the species selected and previous land cover. However, no work has been done to test the scale dependency of forest plantations on biodiversity. In this work, we designed a four-scale hierarchy sampling strategy and used an additive diversity partitioning approach to evaluate the effect of forest plantation on plant species diversity in a mountainous region of Beijing, China. The multi-scale analysis showed that forest plantation changes the partition pattern of species diversity. Our work found that the impact of forest plantation on plant species diversity depends on scale, species assemblage, and species selected. We suggest that a wide range of scales should be considered in the evaluation of the role of forest plantations on biodiversity conservation.

Fragmentation and warming limit populations' ability to track climate across the landscape

Joshua Lawler, University of Washington; Brad McRae, The Nature Conservancy; Tristan Nunez, University of California at Berkeley

Today's landscape is fragmented by roads, cities and farms. However, within the US, these disturbed areas transect millions of acres of natural habitats where plants and animals thrive. As climate changes, organisms living within these natural patches must move if their climate thresholds are exceeded. We examine to what extent fragmented landscapes prevent organisms living in natural patches from moving across the US. We ask how cool of a temperature an organism living in any given natural patch could reach by moving through adjacent natural patches. Given current levels of fragmentation, organisms living in approximately 70% of natural patches would be unable to move enough to stay at uniform mean annual temperatures over the next 85 years as projected under an ensemble A2 emission scenario. We then examined how well they could track their current temperatures if allowed to move across human-impacted landscapes. We created a nationwide connectivity map using climate corridor models. The presence of corridors allows organisms in 28% more natural landscape patches to be able to track their preferred climates. Dispersal across human-impacted landscapes most facilitate movement in the east and along the periphery of the plains and coasts.

Characterizing private forest owner behavior in fire-prone forest landscapes

Jeffrey D. Kline, USDA Forest Service; Eric M. White, Oregon State University; Michael Hall, Oregon State University*

Wildfire risk is influenced by both biophysical factors that determine the likelihood and intensity of wildfire in particular locations and social factors that determine how private landowners perceive and address risk. To be effective, evaluation and mitigation of wildfire risk must address both factors. We will present a conceptual framework describing landowners' propensity to reduce forest fuels and

create defensible space as a function of landowners' wildfire risk perceptions, past wildfire experiences, and biophysical factors including the likelihood of wildfire on the landscape. We will present results testing our conceptual framework using statistical analysis of landowners' activities identified using surveys of private forest landowners in central Oregon (USA). Our results suggest that perceptions of wildfire risk are positively correlated with past experiences with wildfire as well as landscape conditions associated with wildfire hazard predicted by existing fuel models, among other factors. Our conceptual framework and empirical results suggest ways of incorporating private landowner behavior into coupled human and natural systems models of fire-prone landscapes. The coupled biophysical-social approach to managing wildfire risk could provide an improved method for defining both the spatial extent of wildfire risk and improved understanding of private landowners' risk perceptions and willingness to mitigate risk.

Soundscape phenology on an urban-rural gradient

Louis Desrochers, Universite du Quebec Ã Trois-RiviÃ¨res; Raphael Proulx, Universite du Quebec Ã Trois-RiviÃ¨res

How much of the acoustic resource shared by vocalizing animal species is masked by human-induced noise has become a central question in the emerging field of soundscape ecology. The goal of our study was to evaluate the joint probability that masking could occur for anuran, bird or stridulating orthopteran species along the spectral, spatial and temporal dimensions of the acoustic space. We evaluated acoustic overlap in the carrying frequencies, absolute amplitudes (emitter-receiver distances) and acoustic patterns (temporal match-mismatch) of human- and animal-induced sounds in three landscape settings: urban, peri-urban and agricultural. Acoustic overlap was evaluated at day and season scales. Our results suggest that acoustic masking is unlikely for a vast majority of species in the three taxonomic groups and landscape settings studied. Other factors that covary with the amount of noise produced by human activities, like habitat loss and fragmentation, could be more important drivers of species' adaptation in urban settings.

Is sheep grazing an important determinant of fine-scale spatial genetic structure in calcareous grassland plant populations?

Yessica Rico, Department of Natural History, Royal Ontario Museum; Helene H. Wagner, Department of Biology, University of Toronto*

In plants, the strength of spatial genetic structure largely depends on the rates of seed dispersal and pollen flow within and among plant populations. Seeds without dispersal adaptations are likely to be dispersed over short distances (often < 1 m) within the vicinity of the mother plant, resulting in spatial clustering of related genotypes within a population (fine-scale spatial genetic structure, hereafter SGS). However, primary seed dispersal by zoochory can promote effective dispersal across the landscape increasing the mixing of seeds and thus influencing SGS within a population. In this study, we investigated the effects of seed dispersal by rotational shepherding on the strength of SGS and genetic diversity using eleven nuclear microsatellites for 49 populations of the calcareous grassland Dianthus carthusianorum. Populations connected by shepherding showed significantly weaker SGS and significantly higher genetic diversity than ungrazed grasslands. Independent of grazing treatment, small populations (< 40 individuals) showed significantly stronger SGS and lower genetic diversity than larger populations, likely due to genetic drift and inbreeding. A lack of significant differences in the strength of SGS and genetic diversity between populations that were recently colonized and pre-existing populations suggested that populations colonized after the reintroduction of shepherding were likely founded by colonists from diverse source populations. We conclude that dispersal by rotational shepherding has the potential to increase genetic diversity and reduce SGS within D. carthusianorum

populations. This study highlights the importance of considering the mechanisms of seed dispersal across spatial scales to better understand the nature of SGS in plant populations.

Quantifying negative feedbacks between wildland fire and subsequent fire occurrence

Sean A. Parks, Carol Miller, Lisa M. Holsinger - Aldo Leopold Wilderness Research Institute, Rocky Mountain Research Station, US Forest Service*

Several aspects of wildland fire are moderated by site- and landscape-level vegetation changes caused by previous fire, thereby creating a dynamic where one fire exerts a negative-feedback regulatory control on subsequent fire. For example, wildland fire has been shown to act as a barrier to subsequent fire spread and, when reburned, to result in reduced severity of the subsequent fire. However, an in-depth analysis of how wildland fire influences subsequent fire occurrence - that is, whether or not fire ignites and spreads within the perimeters of previous fire - has yet been conducted. In this study, we quantified the influence of previously burned areas on the probability of subsequent ignition along a gradient representing time since fire in four large study areas comprised entirely of protected lands in the western US. We also evaluated how extreme climatic conditions affect the strength of this feedback. Results indicate that fires are less likely to ignite within the perimeters of previous wildland fires, though the strength of this negative feedback varies by study area, lasting eight years in the warm and dry study area and over 20 years in the cooler and wetter study areas. We also found that the negative feedback weakened under extreme climatic conditions compared to more moderate conditions. Our results strengthen the growing body of literature indicating that fuel-mediated negative feedbacks can have a strong effect on subsequent disturbance processes in landscapes with active fire regimes, but that top-down controls such as climate may weaken these feedbacks.

New England Forest Landscape Futures: Scenarios of Harvest, Development, and Climate Change

Matthew J. Duveneck, Harvard Forest; Jonathan Thompson, Harvard Forest; Robert M. Scheller, Portland State University*

New England is among the most forested and densely populated regions in the U.S. The cultural landscape provision a range of complementary and competing ecosystem services, which are threatened by a slow conversion of forest land to developed uses. Variation in anticipated climate and land use change result in large uncertainty surrounding the forest's ability to provision services into the future. Indeed, the relative and interactive effects of climate change, harvesting, and conversion on ecosystem functions and services are not well understood. We used LANDIS-II/PnET-Succession to simulate a continuation of the recent trends of these dynamics and quantified the resulting impacts on forest carbon and species composition. We found that forest growth over the next 100 years resulting from the protracted recovery from nineteenth century land use to be the most important factor influences the future forest. Additionally, the effects of climate change largely outweighed the effects of timber harvesting and conversion on both forest biomass and composition. Specifically, climate change resulted in greater simulated biomass and greater simulated species composition shifts compared to current climate. Forest response to climate was influenced more by increased temperature than changes to precipitation.

Spatial Downscaling of TRMM Precipitation Using an Combined Multifractal and Regression Approach in South China

Guanghua Xu, Xianli Xu -Key Laboratory for Agro-ecological Processes in Subtropical Region, Institute of Subtropical Agriculture, Chinese Academy of Sciences and Huanjiang Observation and Research Station for Karst Ecosystem, Chinese Academy of Sciences;*

The lack of high resolution precipitation data, which are crucial for the modeling and managing of hydrological systems, triggered many spatial downscaling attempts. The essence of downscaling lies on the finding and utilizing of extra information, while scale-invariance property and relationships between precipitation and related geo-referenced factors are mostly applied tactics, which could be indicated by self-similar and regression separately. This study propose an attempt that integrates the information from which indicates this two independent information sources. The approach is applied to 16 year s (1998-2013) of the TRMM 3B43 precipitation data in an orographic and monsoon influenced region in South China. An Artifical Network Model was used for regression with DEM, latitude and longitude as predictive variables, while self-similarity was characterized by multifractal and modeled by a log-normal multiplicative random cascade. The original 0.25Â° Ã— 0.25Â° scale precipitation field was then downscaled to 0.01Â° Ã— 0.01Â° scale , good consistency was achieved when validated with rain gauge data.

A Canadian perspective on landscape pattern to enhance farmland biodiversity

Lenore Fahrig, Geomatics & Landscape Ecology Research Laboratory (GLEL)/Carleton University; Kathryn Lindsay, Environment Canada/GLEL; Doug King, GLEL/Carleton University; Scott Mitchell, GLEL/Carleton University; Lutz Tischendorf , ELUTIS Modelling and*

In Canada, the frontier for extinction risk is in agricultural regions which support over 550 species of terrestrial vertebrates, including about half of species classified as "at risk". Conservation of the environment is important to Canadians and contributes to the Canadian economy through the provision of ecological services such as pollination and pest control for agriculture. The goal of the research to be presented was to develop ways of conserving and/or enhancing farmland biodiversity through modifications of landscape structure, without reducing the area under production. Birds, bats, anurans, butterflies, bees, syrphids, carabids, spiders, plants, predation and pollination were measured in 93 agricultural landscapes near Ottawa, Canada, in 2011 and 2012. Landscape heterogeneity was measured for composition (crop cover diversity) and configuration (mean crop field size) at different spatial extents (1 to 3 km). Analyses of 1x1km landscapes showed that all taxa and services responded negatively to increasing mean crop field size. Thus, incentives for farmers to limit field enlargement and reduce crop field size, should benefit farmland biodiversity. Additional research compared measures of heterogeneity from continuous spectral information versus discrete classification of Landsat imagery. For birds and plants, predictors derived from continuous information of crop productivity (NDVI) consistently ranked higher than predictors derived from discrete classification. Local measures of spatial autocorrelation (e.g. Moran's I) were useful indicators of spectral heterogeneity. Thus, analysis of satellite data can help inform assessments and agri-environmental policy development for conservation and/or enhancement of farmland biodiversity over regional and continental scales.

Assessing the relative importance of local vs. landscape level actions to develop ecological networks

Elisa Fuentes-Montemayor, University of Stirling; Kevin Watts, Forest Research; Nicholas Macgregor, Natural England; Kirsty Park, University of Stirling.*

Current actions to reconnect fragmented landscapes include creating new habitat patches, expanding, connecting and restoring existing patches, and increasing the permeability of the surrounding matrix habitat to develop 'ecological networks' (a suite of core habitat areas connected by buffer zones, corridors and 'stepping stones' that allow movement of species or their propagules). However, limited empirical evidence on the relative merit of alternative actions to develop ecological networks (e.g. increasing habitat area vs. connectivity) has resulted in much uncertainty on how to prioritise

conservation activities. In the UK, long-term deforestation has drastically reduced woodland extent. However, this fragmentation process has been followed by decades of woodland creation (e.g. through woodland planting schemes) which has inadvertently created a series of historical test landscapes where woodland patches represent the different components of ecological networks (e.g. buffers, linkages and stepping stones). As part of an ongoing collaborative research project (Woodland creation and Ecological Networks; WrEN) between academics, policy makers and conservation practitioners, during 2013/14 we surveyed 100 secondary woodland patches to study how different taxa were influenced by local- and landscape-level woodland characteristics related to the ecological network concept. Surveys focused on a range of species with different life-history traits (e.g. habitat specificity and dispersal abilities). Preliminary results suggest that taxa differ in their response to local- and landscape-level woodland attributes, depending partly on their dispersal abilities. Local-level conservation activities are likely to be particularly important for lower-mobility species. For higher-mobility species, both local- and landscape-level actions are required.

Sustainable development provided by landscape identity approach In world natural heritage; "Sourt" springs, Iran

Mahsa Bazrafshan, Environmental designer; Alireza Mikaeili Tabrizi, Landscape Architect.*

There is a growing concern about the way of development in different areas. Of course it's a globally issue and applies for different cases. Natural heritage especially with geographic feature is one of the most important areas with rich potential for developing tourism. There is need to develop non-monetary method to assessment of landscape identity in order to integrate them into the basic sustainable framework in a more balanced way. 'Sourt Springs' is recorded as a natural heritage in Iran and is one of three world famous fountains that have unique and specific geology with a series of terraced basins formed during time. This area Derive from 3 springs with different taste in a cliff almost 1000 m high overlooking the plain in top of a foothill in North of Iran. A useful method for homogenous design with basic element of area is visual impact assessment after development. In this vein we need to know what services will prepare by landscape and how it's function in future. The assessment methodology adopted by HASSELL draws reference from the "Best Practice Guidelines", Australian Wind Energy that use in this research. HASSELL prepare a schematic image of region after development through measuring two factor; visual effect and visual sensitivity. As a conclusion methods for valuation of natural heritage and identity in landscapes are integrated into assessments of sustainable design to inform policy making and physical and spatial planning for sustainable management of ecosystems and landscapes.

Land Surface Temperature and its impact on Asian elephants forest landscape: a case study from Tamilnadu, South India.

Tamilelakkiya.M1 and Dr.G.Bhaskaran2: 1Research scholar, Department of Geography, 2Assistant professor, Department of Geography, University of Madras, Chepauk campus, Chennai.*

Satellite images offer the basis for discerning the pattern of fragmented natural habitats in different spatial scales. Development needs have significantly modified natural landscapes and have led to natural habitat as various fragmented units. Species like elephant are one of the major animals currently suffering due to anthropogenic interventions. Thus, there is a need to focus on endangered Asian Elephants and its habitat restoration efforts. Geospatial technology provides spatially explicit solutions to understand the way the natural community have been organized. We present the scientific background and technological analyses to identify the forest fragmentation, increase in barren surface and the built-up lands along the fringes of the forest area and its impacts on elephant populations in

human-forest matrix landscapes. Land Surface Temperature (LST) is an important climate change indicator. It varies spatially and temporally due to the influence of the vegetation cover, surface moisture, soil types, and topography as well as meteorological measures. It's mainly used to identify the land surface change activities like foraging and clearing. The study observed the increase in built-up land and barren lands along the forest fringes with the negative correlation between LST and NDVI. Spectral analysis which included creating LST and NDVI has done using multi-temporal Landsat TM data. The results generated from the spectral analyses, supervised classification and elephant disturbance map were used to assess the spatial pattern and temporal variation of Land use and land cover of the area and its impact on elephant's landscape. Finally the study revealed that among the two different elephant landscape there is a positive correlation between the LST, and the elephant disturbance density in the elephant conflicted landscape.

Fen restoration in abandoned pasture in northern Japan, Hokkaido

Junko Morimoto, Masatoshi Shibata, Futoshi Nakamura, Hokkaido University

The restoration of fallow farmland to natural ecosystems will promote biodiversity conservation and disaster prevention. Successful restoration of fallow farmland in marsh areas requires specific planning. We investigated the probability of fen restoration in fallow grasslands in Hokkaido in northern Japan. The vegetation and environments of grasslands, fallow grasslands with different fallow periods, and residual fens were examined. The soil seedbanks in these areas at depths of 0-5 cm and 5-10 cm were evaluated under wet and flooded conditions. Ground water levels rose soon after grasslands became abundant, and hygrophyte species appeared in fallow grasslands. The species composition of fallow grasslands that were abandoned 25 years ago and residual fens were similar. Hygrophyte species were dominant in these grasslands, but some pasture species remained. The soil seedbanks of fallow grasslands included hygrophyte species observed in residual fens that were not observed in the ground vegetation. The soil seedbanks of the fallow grasslands were free from pasture species. Hygrophyte species germination was greatest when the topsoil was spread out under wet conditions. Some rare species germinated only under flooded conditions. These results demonstrate that several treatments, such as raising ground water levels by filling open ditches with soil, tilling the topsoil, and creating various ground water levels by drilling ground to different depths, accelerate fen restoration. These treatments will weaken pasture species dramatically and will promote the germination and growth of various hygrophyte species from the soil seedbank, which should restore the fens which is similar to those present before development.

Citizen-based tools help to interpret bird populations in the Pacific Northwest coast

Joy Wolf, University of Wisconsin - Parkside

Long-term efforts for citizen-based monitoring of bird populations include the Christmas Bird Count, more than 100 years and the North American Breeding Bird Survey, almost 50 years. Cornell Lab of Ornithology's Ebird has since incorporated this data which allows researchers to combine their own observations with large databases to reveal historical patterns. I joined local birders and citizen groups to collect data for 10 months from habitats of old-growth forests, marshes, coastal cliffs, and edge/rural. I used the IBird digital application for accurate field identification. Species, abundance, location, habitat, and song were then entered into the Ebird website. Site-specific communities emerged. Pacific flyway species in coastal forests include Pacific wren, black-headed grosbeak, Hutton's vireo, black-throated grey warbler, Anna's hummingbird, wrentit, chestnut-backed chickadee, red-breasted nuthatch, Swainson's thrush, red-breasted sapsucker, Pacific-sloped flycatcher, black phoebe, Western screech owl. In old growth habitat, 68% bird species were unique compared to adjacent rural habitats (19% were

unique in rural sites). Coastal cliffs shared 32% with old growth; marshes differed by latitude. Old growth had abundant varied and hermit thrush, juncos, kinglets, and pileated woodpeckers in winter. In 2013 the Oregon coast experienced an unusual drought. Continued monitoring of migration and nest timing will determine shifting resources for birds with restricted habitats such as wrentits. Sequoia and Port Orford cedar forests may provide narrow southern corridors in the future for otherwise northern species.

Global Island Biocultural Diversity Initiative: Background, Progress and Goal

Sun-Kee HONG, Institution for Marine & Island Cultures, Mokpo National University, Korea

Biological and cultural diversity have a mutual relationship in which one cannot be detracted from the other. The interest in 'biocultural diversity' is gradually increasing globally, and this brings about the need for basic research projects focused on the preservation of biocultural diversity. This involves efforts for the promotion, expansion, and construction of networks to discuss results and matters for deliberation (IUCN Resolution 5.115) adopted at the 2012 World Conservation Congress (WCC). As part of this initiative, identification of the development and mechanisms regarding 'Island-coastal biocultural diversity in Asia-Pacific regions' and the establishment of conservation strategies are pursued. Moreover, the initiative involves construction of an information base regarding characteristics and traditional ecological knowledge of island biocultural diversity, implying setting up a database and suggesting action plans for designation, maintenance, and preservation according to vulnerability. The initiative will play an important role in expanding the relationship with IUCN through short- and long-term strategic establishment of initiatives, composition of domestic and foreign academic programs, cooperation on initiative contents with domestic and foreign institutions, coordination of South Korea, and reinforcement of collaborations with CBD and other international organizations. The final goal of the initiative is to preserve island biological and cultural resources in the Asia-Pacific region in the face of climate changes as well as to contribute to sustainable living of local residents.

An optimization approach to assessing landscape-scale energy development effects on rare plant species in the Colorado Plateau of western North America

Thomas C. Edwards, Jr., U.S. Geological Survey and Utah State University; Rico W. Hergert, Swiss Federal Research Institute WSL; Robert D. Fitts, Utah State University; Felix Kienast, Swiss Federal Research Institute WSL

The Colorado Plateau of western North America contains large energy reserves currently under development or proposed for development. The Plateau is also home to considerable biodiversity, especially plant species that have limited distribution and localized adaption. We modeled the distribution of 15 plant species under consideration for ESA listing, with an objective of minimizing the spatial conflict between energy extraction and plant-specific distributions. Separate species distribution models were constructed for each of the 15 species using 5 common modelling algorithms (logistic GLM, additive logistic GAM, MAXENT, Random Forest, Boosted Regression tree). Ensembles were built from the models. We next obtained energy extraction potential, a scored (1-100) value representing low to high energy value as determined by energy producers. Using a MARXAN framework, we next ran 5 different scenarios of plant-protection vs. energy development and rank-ordered the locations of potential conflicts from highest to lowest. Results indicate that upwards of 80% of the higher energy potentials could be realized while affording protection of 80% of the combined modeled and known distributions of the species. Several species had such limited distributions that virtually 100% of their respective ranges were required to meet target conservation goals. Variable land tenure complicates the

findings given a mixture of private and state lands co-mingled with Federal lands, each of which has different required legal responses under ESA listing.

Modelling tree species migration in the European Alps under climate change

Heike Lischke, Dirk Schmatz

Distribution and dynamics of tree individuals and species in space are determined by species' traits, population dynamical processes, biotic and spatial interactions, all influenced by environmental and anthropogenic drivers. Bottom-up model approaches and challenges to incorporate these elements will be shortly presented. As an example for such a modelling approach, I tested the effect of tree species migration on the ability of tree species to follow climate change induced shifts of their potential ranges. I ran simulations until 2100 over Switzerland in 200m resolution with the spatio-temporal forest landscape model TreeMig. The model was adapted to represent roughly current species distributions. Starting from these, I simulated future forest development with different scenarios of a) transient climate change b) land-use change and c) migration (seed dispersal vs. ubiquitous seeds). The results suggest combined effects of environmental and anthropogenic drivers, migration and species interactions. Biomass decreases, particularly in low elevations, mainly due to extreme drought events. At high elevations, it increases due to rising temperature and by the colonization of abandoned meadows. Species compositions change, drought adapted species become dominant in the lowlands, and most species shift their ranges upwards. Migration delays these upward shifts intermediately; migration delays of dominant species can favor competitors.

Small wooded elements in farmlands promote bees with high pollination efficiency

Romain Carrie, University of Toulouse; Annie Ouin, University of Toulouse; Emilie Andrieu, INRA, UMR DYNAFOR, Chemin de Bo*

Insect pollinators play a pivotal role in agricultural landscapes, supporting both biodiversity and food production. Wild bees are the most efficient crop pollinators throughout the world but their diversity is threatened by the simplification of agricultural landscapes via important losses of semi-natural habitats. These non-crop perennial elements (woodlots, hedgerows and permanent meadows) provide essential resources for wild bees in agricultural landscapes. In this study, we aimed at investigating the functional response of wild bee communities to the proportion of various semi-natural habitats. We selected 20 landscapes in southwest France (1x1 km, varying in proportion of wooded elements and permanent meadows) and sampled pollinators in 3 crop fields per landscape during spring 2013. A set of 5 traits related to pollination efficiency (flight duration, dietâ€¦) and sensitivity to habitat fragmentation (inter-tegular distance) were attributed to species as much as possible. 2816 individuals from 82 species were trapped in the 60 studied fields. Bee species were assigned to functional groups and a redundancy analysis was used to explore the link between landscape metrics and functional group distribution. Wooded landscapes were significantly associated with bees having short foraging ranges (small body size) and with a long and efficient pollinating activity (long flight period, sociality). This study emphasizes the role of wooded semi-natural elements in structuring wild bee functional assemblages within crop fields, and their importance in both buffering agricultural intensification and promoting pollination services.

Predator community structure, diversity, and tick-borne pathogens

Taal Levi, Oregon State University; Michael Barfield, University of Florida; Robert D. Holt, University of Florida; Felicia Keesing, Bard College; Richard S. Ostfeld, Cary Institute of Ecosystem Studies*

There is growing recognition that changes in host community ecology and trophic interactions can contribute to the emergence of infectious diseases. Many diseases cycle enzootically, but are transmitted to humans from their wildlife host either by direct contact, or more often by an arthropod vector. Because many zoonotic pathogens are harbored by wildlife that occupy low trophic levels (particularly rodents), predation of reservoir hosts may be critical to disease suppression, but this is still poorly understood. A paradigmatic case of disease emergence that is driven by changes in the host community is Lyme disease-the most prevalent vector-borne disease in North America. The increases in Lyme disease in the northeastern and midwestern USA over the past three decades coincide with a range-wide decline of a key small mammal predator, the red fox, likely due to expansion of coyote populations. This research explores the hypothesis that changes in predator community structure have facilitated the emergence of Lyme disease by sampling the abundance and infection prevalence of the vector and host community in fox-dominated and coyote-dominated sites and by incorporating predation and vertebrate community structure into disease models. We further use field data to explore the effect of host diversity on Lyme disease risk.

Modelling the effects of climate change on forest landscapes in Canada: new national tools for spatially explicit process-based models

Yan Boulanger, Natural Resources Canada, Canadian Forest Service, Laurentian Forestry Centre; Dominic Cyr, Natural Resources Canada, Canadian Forest Service, Laurentian Forestry Centre; Anthony Taylor, Natural Resources Canada, Canadian Forest Service*

Northern forest ecosystems are at the forefront to face strong climate-induced alterations of forest structure and composition in the next decades. A projected northward shift in isotherms might result in range modification for various tree species potentially displacing biome boundaries. Furthermore, projected changes in the natural disturbance regime, notably fire, might also significantly alter forest properties. Spatially explicit process-based models are well-suited to more robustly appraise the complex interplays between climate as well as natural and anthropogenic disturbances in a changing climate. Climate responsive species-specific growth models and rather fine-scaled spatially explicit data about initial and future conditions are, among others, required for such models. Over the last few years, the Canadian Forest Service (CFS) has developed several tools and products to allow simulations of forest landscapes throughout the country. We briefly describe some of these tools here. Moreover, we present how these are applied for the parameterization of LANDIS-II in order to simulate forest landscapes in all Canadian forested ecozones. Preliminary results regarding the impact of climate change per se, logging and natural disturbances for eastern ecozones are presented.

Experienced landscape on a heritage route: Visitor Employed Photography

Shiwei Gou, Kyoto University, Graduate School of Global Environmental Studies; Shozo Shibata, Kyoto University, Graduate School of Global Environmental Studies*

Studies of experience, although complicated, have two major components: the physical setting of the landscape elements and the social interactions. An operational definition was proposed by Hull and Steward (1995) for "experienced landscape" through a certain activity of hiking to describe the holistic, integrated person-environment system created by a linear corridor of path. Following this concept, this study explored the landscape experienced by hikers along a popular section (6.9km) of a heritage route, Nakahechi of Kumano pilgrimage routes utilizing visitor-employed photography supplemented by focus group techniques. The major objectives are to (1)identify landscape features that enhance hikers' experience; (2)differentiate the patterns of experience for groups walking with locals guides or not; (3)understand the feelings behind and to study (4)credibility of visitor employed photography. Using

content analysis, 8 themes aggregated from 24 subjects were identified from 837 photos taken from 30 groups of people who participated the survey before hiking. Major rationales behind the photos were revealed by focus group. Differences were detected not only from the contents of photos taken by groups with local guides or not but also the sequence revealed by the cluster analysis in ArcGIS for the location of the photos. At last, a group of 15 people who were approached by the end of their hike certified that visitor employed photography might be biased since people participated in the survey from before their hike tends to take more photos ($p<0.001$) especially of greater detail compared to taking photos out of natural habits.

Fish connectivity in stream networks

Marie-Josee Fortin, Andrew Chin, Julia Linke - Department of Ecology and Evolutionary Biology, University of Toronto, Canada; Roland Cormier, Eco-Risk Management, Moncton, Canada; Carole Godin, Fisheries and Oceans Canada, Moncton, Canada*

Species movement can be impeded by landscape heterogeneity due to roads, landcover types, rivers, etc. In terrestrial ecosystems, various landscape connectivity techniques (e.g. probability of connectivity index) can be used to quantify the degree of spatial connectivity. In aquatic stream networks fish movement can be impeded due to the presence of culverts and dams. Stream connectivity is in fact crucial for diadromous fish functional connectivity because their ability to pass through obstacles is highly dependent on fish swimming ability and strength to jump. Stream networks due to their dendritic structure require the use of new connectivity algorithms that include explicitly flow directionality. This can be achieved by modifying the probability of connectivity index to account for stream dendritic structure and directionality. Such a probability of directional connectivity index can therefore be used to investigate how culverts impacts stream connectivity over the entire length of the stream and its tributaries. The probability of directional connectivity index can provide a mean to rank streams in term of their connectivity and this according to fish swimming abilities. To illustrate the usefulness of the probability of directional connectivity index and how fish move through altered stream, we use culverts data from New Brunswick (Canada) and fish swimming traits from the literature.

Process-based models are necessary when pattern matters: the case of Amazonian deforestation.

Eugenio Arima, Department of Geography and the Environment, The University of Texas at Austin

Land change models (LCMs) are now part of the toolkit of environmental scientists and are increasingly being used to inform policy makers about the effects of socio-economic and institutional forces that drive the dynamics of landscape change. LCMs have also been used to model landscape fragmentation outcomes. In tropical environments, forest fragmentation has emerged as an important environmental issue, given that the spatial pattern of deforestation can compromise ecological processes. A large literature exists on the drivers of tropical deforestation and its ecological consequences but less is known about its spatial manifestation into patterns of fragmentation. I address this issue for the Brazilian portion of the Amazon basin by considering the social processes that create landscape patterns. I argue that fragmentation patterns generally emerge by virtue of road construction and agricultural property formation. As such, process-based LCMs are necessary when interest lie in the replication or prediction of landscape patterns. I present examples of such models and conclude by placing the discussion within legal and institutional context, and observe several policy implications for resource managers.

Distance within scales: explaining landscape and regional variation in alpine tundra

George Malanson, University of Iowa & NSF; Dale Zimmerman, University of Iowa; Mitchell Kinney, University of Iowa; Dan Fagre, USGS NRMSC

Understanding local responses to global change requires landscape and regional contexts. As part of a multiscale analysis, spatial metrics (which may be surrogates for processes of dispersal and diffusion at multiple time scales) can provide some explanation. Scores from ordinations of cover data from alpine tundra sites in four locations the Rocky Mountains are regressed on Moranâ€™s Eigenvector Mapping (MEM) vectors and compared to Mantel tests using the same distance matrices and the vegetation dissimilarity matrix used in the ordination. While Mantel tests use data closer to its original form, they do not provide the spatial insights of MEM, which can be mapped on geography. These analyses of the four individual locations are compared to a multilevel regression analysis that uses regional climate variables at the coarse scale. The former, multiscale, analyses are more informative than the multilevel analysis because the important independent variables differ among locations.

Landscape dynamic change and its hydrological driving in Bayanbulak Wetlands

Wang Shengzhong,School of Geographic Science, Northeast Normal University

The Bayanbulak Grassland, which is located in the Xinjiang Uygur Autonomous Region of China, is a typical subalpine meadow in the arid area. It lies on the Youerdusi Basin, a high-elevation intermontane basin on the southern slope of the Tianshan Mountains. Wetlands are widely distributed on the bottom of the basin. The aim of this study is to analyze landscape change and the driving factors of wetlands in Bayanbulak Grassland. Landscape pattern and dynamic change of wetlands are determined by the transition matrix and landscape index interpreted from the remote sensing images in 1998, 2006 and 2014, respectively. The results show that, in past 25 years, (a) the total wetland area has been increasing but more fragmented; (b) the patch shape became more complex and their dominance somewhat decreased; (c) patches are more evenly distributed. Gray-connection analysis shows a significant relationship between the indexes of landscape pattern and hydrological factors. The landscape shape index, edge density, Shannon diversity index, and Shannon evenness index have significant relevance with precipitation and runoffï¼Œindicating that precipitation and runoff have obvious influences on the shape, edge, richness and evenness of the landscape. Human disturbance, especially road building for tourism circled around wetlands, has increasingly contributed to the changes of hydrology. The roads have obstructed runoff channels and changed hydrological pattern. Supplying water has been overly collected from sheet flow into channels. These disturbances result in the fragmentation of wetland landscape.

ES provision and ES demands - the challenge to balance spatial mismatches

Ralf-Uwe Syrbe, Leibniz Institute of Ecological Urban and Regional Development, Dresden, Germany

Ecosystem services are generated by several ecosystem types. Since benefits are used and appreciated permanently, the highest demand is where most people are. Though urban and anthropogenic ecosystems generate them as well, valuable ecosystem goods and services originate from distant areas to the benefiting people. The evident spatial disparity between provision and demand requires suitable rules to bring them together. But possible solutions depend strongly on the spatial type of ecosystem services' transfer as well as from the landscape structures and the people shaping it. The spatial relations can be classified into six types with regard to the relocation of matter or men and to the affected groups of people. Some providing services need actors who maintain provision and carry goods.

Other services are used by the beneficiary coming to the ecosystems. But these are only the two plainest types. For all of them, specific scientific methods and different policy approaches are applicable. A crucial issue is how to deal with the actors who enable, maintain, restrict, and even provoke ecosystem services. Methods of landscape maintenance, conservation support, and private solutions are discussed. The contribution suggests the framework of institutional analysis and development (IAD) to analyze and improve the concerned social-ecological system and to master the above mentioned challenge.

Decreasing spatial variability in precipitation extremes in SW China: determined by the South Asian Monsoon?

Meixian Liu, Xianli Xu, -Key Laboratory for Agro-ecological Processes in Subtropical Region, Institute of Subtropical Agriculture, Chinese Academy of Sciences and Huanjiang Observation and Research Station for Karst Ecosystem, Chinese Academy of Sciences*

Frequent climate extremes have caused devastating damages to human society and ecosystems. Recent studies have drawn many conclusions about trends in climate extremes, but few have focused on quantitative analysis of their spatial variability and corresponding mechanisms. By using the techniques of overlapping moving windows, Mann-Kendall (MK) trend test and statistical methods, this study examined the spatial-temporal variation of precipitation extremes and investigated the potential influencing key factors in southwestern (SW) China, a globally important biodiversity hotpot but a climate sensitive region where the climate is primarily controlled by the South Asia monsoon. Results showed that the changing trends of precipitation extremes were not spatially uniform, but the spatial variability of these precipitation extremes was decreasing during the period of 1959-2012. Further analysis suggested that atmospheric circulations rather than local factors (land cover, topographic conditions, etc.) were the determinants of such behavior of precipitation extremes. This study implied that droughts or floods would be more homogenously widespread throughout the whole SW China, and suggested that region-wide assessments and coordination were needed to mitigate the economic and ecological impacts caused by natural hazards.

Improving energy productivity for water supply, distribution, and treatment

Sa'd Shannak Research Associate King Abdullah petroleum studies and research centre

Natural resources management in the context of international development and how to secure quality of life for both present and future generation is an important research question that very few studies have investigated. Several challenges and real crisis were raised in the current and last century due to the lack of holistic approaches that fully understand the interlinkages between natural resources. Comprehensive solutions that should help decision makers and global community in better planning and managing these resources cannot be developed without improving and promoting for the productivity of these resources. Every society requires water for drinking, bathing and crop irrigation, and most of the available water requires energy to be moved and treated prior to use. For planning policy purposes, the available literature focused on either planning for drought as a particular water scarce event, or planning for energy conservation for a given conditions, but it does not go beyond the issue of energy-water nexus as a permanent condition. Energy-water challenges and interactions are often studied at a watershed scale, this paper was an exploratory investigation of the interconnectedness between the two systems on a national level across a range of countries. This effort could help design a stakeholder framework for planning and enhancing the productivity of energy for water on a national level. Energy productivity was estimated for different water consumption scenarios in order to optimize the return of economic output from water supply, distribution, and treatment at a given energy supply. The

contribution of water in each sector was estimated and evaluated with respect to yield per input and GDP per unit for the different sectors. The scenario that had greatest energy productivity would contribute to increase the communities' benefits from this resource and would allow for more extra freshwater and energy to support the biodiversity and the global economy.

Lake Management in the Urban Agglomeration of Lake Biwa Region, Japan: Ecosystem Services-Based Sustainability Assessment

Ken'ichi Nakagami, Ritsumeikan University; Xiaochen Chen, Ritsumeikan University; Jia Niu, Ritsumeikan University; Xuepeng Qian, Ritsumeikan Asia Pacific University; Jun Nakajima, Ritsumeikan University; Jianhua Li, Tongji University; Ji Han, East China*

Lake, as a unique ecosystem, has great environmental, economic and social values. However, fast urbanization often has negative impacts on it, and its deteriorative ecosystem services in turn seriously holds back the healthy urban development. Based on a case study of Japanese urban agglomeration possessing lake of international importance, development path toward sustainability was investigated. The study area was Lake Biwa Region, which includes Shiga Prefecture (one of Japanâ€™s leading â€œmanufacturingâ€ prefectures) and downstream mega-cities of Kyoto, Osaka and Kobe. An original indicator system was established, based on the four major ecosystem services of Lake Biwa, i.e., provisioning, regulating, cultural and supporting services. By applying it, the sustainability of this entire region over more than six decades was quantitatively assessed. Then through in-depth analysis of anthropogenic exploitation and management trajectory of Lake Biwa, both the painful lessons and advanced experience involved in this case were thoroughly discussed. This study once again arouses peopleâ€™s awareness of the indispensable role of lake in sustainable urbanization, and the valuable knowledge obtained is informative and inspirational for many other urban agglomerations facing similar types of development issues.

Determinants of conifer distributions across peatland to forest gradients in the coastal temperate rainforest of southeast Alaska

Sarah Bisbing, California Polytechnic State University, David Cooper, Colorado State University, David D'Amore, USDA Pacific Northwest Research Station, and Kristin Marshall, University of Washington*

Wetland determination relies on the concept that species are limited to certain environments by site conditions, and species' wetland indicator status assumes that tolerance of wetland conditions best explains distributional patterns. However, abiotic and biotic factors often interact to create complex plant responses across different environments. To evaluate these interactions, we used a hydrologic gradient in the coastal temperate rainforest of southeast Alaska to: 1) quantify the primary constraints on conifer distributions, 2) identify thresholds in environmental factors limiting species' success, and 3) assess current wetland indicator status of local conifers (Pinus contorta, Picea sitchensis, Tsuga heterophylla). Data was collected using a hierarchical sampling schema and analyzed within a Bayesian framework. Topography and hydrologic regime were the primary determinants of distributional patterns, but species were limited by specific microsite factors. Competitively-dominant P. sitchensis occurred where hydrology, pH, and nitrogen were most favorable for tree establishment, while stress-tolerant P. contorta was competitively excluded from these sites. Tsuga heterophylla was highly plastic but took advantage of drier conditions, which promoted biomass accumulation. Distributions were more limited by interacting abiotic and biotic factors than by tolerance of abiotic factors alone, and results suggest that wetland indicator status be revisited for these species. This knowledge of local and regional drivers of species' distributions and the relative importance of interacting abiotic and biotic drivers provides critical information for land management and regulation. Wetland delineation procedures can

be improved through application of the empirical limits identified for each species, as implemented and addressed in this study.

Managing landscapes for ecosystem services and biodiversity

Taylor Ricketts, University of Vermont

Conservation efforts increasingly focus on human benefits. As a result, the goals of landscape management have expanded to include supporting both biodiversity and ecosystem services. The degree of synergy between those two goals, however, remains unclear. If ecosystem services are a function of biodiversity itself, or if both respond similarly to landscape variables, we can expect concordance between areas of high biodiversity and high service production. However, ecosystem services involve not only biophysical supply, but also societal demand. The spatial pattern and behavior of beneficiaries therefore adds complexity and probably weakens synergies between biodiversity and ecosystem services at landscape scales. I illustrate these issues with examples from local pollination experiments, landscape and regional modeling work, and global biogeographic studies. This diverse evidence indicates that landscape management efforts cannot assume that biodiversity and ecosystem service goals are aligned. Instead, managers need to quantify and map both, and work to understand and minimize the trade-offs between them.

Panel Discussion / Session A: Planning Innovations through integrating wisdom, research and practice

Christian Albert, Leibniz Universitat Hannover & Helmholtz Centre for Environmental Research - UFZ; Vivek Shandas, Portland State University; Wei-Ning Xiang, University of North Carolina at Charlotte & East China Normal University*

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Proposing limits to urban sprawl in Switzerland

Christian Schwick, WSL, Anna Hersperger, WSL, Jochen Jaeger, Concordia University*

Urban sprawl is a serious threat to sustainable land use in Switzerland. The role of spatial planning to control sprawl is ambiguous and seems limited, given the fact that sprawl in Switzerland has risen continuously since 1885 and has increased more than six-fold in the last 125 years, and no reversal of this trend is foreseeable. Therefore, we developed a method for formulating targets and limits to sprawl on the basis of scientific data, using the WUP-metric for measuring sprawl. For Switzerland, we propose a limit of 2.5 DSE/m2, i.e., no further increase of sprawl is allowed, Based on this overall value, we derive individual limits to sprawl for the municipalities and cantons, considering the differences between the regions, their current level of sprawl, their future population increase, their natural conditions, and their potential for densification. Earlier limits and targets for other environmental issues like water and pollution control and forest protection has clearly improved the situation in Switzerland. We therefore argue that the results of our study will more effectively support efforts to control urban sprawl in Switzerland than in the past. The method can also be applied in other countries in the same way. An ArcGIS tool for the calculation of WUP and an Excel table for the calculation of individual limits of sprawl will be made publicly available.

The landscape of abandoned farmland of commercial arbour crops in Japan: Giant bamboo and mulberry groves

Shigeo Suzuki(Rissho University)*

Landscape changes in old fields are a relevant issue in cultural landscape research. Japan has several commercial arbour croplands, which are characterized by a woodland cultural landscape. Recently, several of these arbour croplands have been abandoned because of replacement of the metals and plastics industries, an increase in imports from other countries, and the aging farmer population. The giant moso bamboo (Phyllostachys pubescens) was imported to Japan from China in 1736. In the 19th century, planting of bamboo for obtaining edible young shoots was prevalent. However, after the 1980s, the use of boiled bamboo shoots imported from China increased, and many of the bamboo-producing villages collapsed. The abamdoned moso bamboo became the centre of invasion to the adjacent cultivated fields and traditional satoyama woodlands. The mulberry tree (Morus alba), whose leaves are eaten by silkworms, was one of the major arbour crops in Japan. In the late 19th century, silk filatured from silkworms was the most important export item of Japan. There were many mulberry-growing lands in the hilly and terrace terrains close to filaturing factories, mainly in East Japan. However, since the 1980s, the filaturing factories have gradually closed owing to the rise in the value of the yen. Therefore, large areas of mulberry groves have been abandoned and the lands were invaded by Pleioblastus chino or Pueraria lobata, which produce tall bushes. Because of these landscape changes and abandonment of commercial arbour croplands, the satoyama landscape of Japan has deteriorated.

Using state-and-transition simulation models to evaluate alternative invasive plant management strategies at the landscape scale

Catherine S. Jarnevich, Tracy R. Holcombe, Catherine Cullinane Thomas -U.S. Geological Survey Fort Collins Science Center; Leonardo Frid, Apex Resource Management Solutions Ltd.; Aaryn Olsson, School of Earth Sciences and Environmental Sustainability, No*

Land managers are often faced with trade-offs in allocating limited resources to fighting plant invasions. These decisions must often be made with uncertainty about the location of infestations, their rate of spread and effectiveness of management actions. Landscape level simulation tools such as state-and-transition simulation models (STSMs) can be used to evaluate the potential long term consequences of alternative management strategies and help identify those that use resources most efficiently. Here we present an application of a spatially explicit STSM to evaluate alternative management strategies for African buffelgrass (Pennisetum ciliare syn. Cenchrus ciliaris) at Ironwood Forest National Monument (IFNM) in Arizona. The model used in this application incorporates buffelgrass dispersal and establishment as well as management actions including inventory, treatment and post treatment maintenance. We simulated a number of alternative scenarios developed in consultation with buffelgrass managers and other stakeholders at IFNM. Scenarios vary according to the total budget allocated for management and the allocation of that budget between different kinds of management actions. Results suggest that to achieve an actual reduction and stabilization of buffelgrass populations, management unconstrained by fiscal restrictions and across all jurisdictions and private lands is required; without broad and aggressive management, buffelgrass populations are expected to increase over time. However, results also suggest that large upfront investments can achieve control results that require relatively minimal spending in the future. Investing the necessary funds upfront to control the invasion results in the most efficient use of resources to achieve lowest invaded acreage in the long-term.

The relationship between social values for ecosystem services and land cover/land use in Norway

Dr. Vera Hausner, Arctic University of Norway

A limited number of studies have examined the relationship between social values for ecosystem services and land cover/land use features. For example, Brown (2013) examined the relationship

between social values for ecosystem services and global land cover in a meta-study of 11 public participation GIS (PPGIS) studies completed in the U.S., Australia, and New Zealand that comprise a diverse set of temperate ecoregions. This presentation will provide further empirical evidence on the relationship between physical landscapes and social values for ecosystem services by analyzing results from two PPGIS studies undertaken in Norway in 2014-2015. We will assess whether, consistent with previous findings, the highest frequencies of social values for ecosystem services are associated with forests, whether water bodies are most valuable relative to the area occupied; and whether agricultural land and areas of permanent snow and ice are least valuable to Norwegians. It appears plausible that the relationships found between cultural values and physical landscapes in temperate ecoregions will differ from those in arctic and sub-arctic ecoregions that characterize Norway. We will use multiple evaluation criteria to determine the importance of landscapes in Norway for providing social values for ecosystem services-abundance, density, proportionality, and diversity.

The demands of aging people for cultural ecosystem services

Chen Wen, Institute for Environmental Planning, Leibniz University Hannover; Christina Von Haaren, Institute for Environmental Planning, Leibniz University Hannover; Christian Albert, Institute for Environmental Planning, Leibniz University Hannover*

This research is to survey the demands of aging people for cultural ecosystem services. Cultural ecosystem services (CES) are non-material benefits provided by ecosystem services, mainly including cultural identity, cultural heritage, spiritual enrichment, cognitive development, aesthetic experience and opportunity for recreation and tourism. Currently assessing CES is still insufficient due to the intangible, indirectly, and diverse social-cultural characteristics. Treating elderly people as users of ecosystem, on one hand, is to response the issue of well being of human provided by ecosystem in global demographic change, on the other hand, is helpful to understand the delivery process of CES by studying demands of a group of people in certain context. The objective of the research is to develop a framework as buffering area to translate the theoretic research of human basic needs in social science into demands of CES, and to link the population aging as driving factors to these demands. Besides literature review, empirical study will be conducted to study the urban green landscape utilisation situation for aging people in Hannover, Germany, by observation, interview, and questionnaire. The demands of aging people for CES are to be categorised. To some degree, a selection of indicators for possible expressing the demands of aging people for CES would be discussed, as the preparation for possible future research.

Coral reef connectivity in Palau:
A population genetics approach to coral reef management in warming seas.

Annick Cros, Hawai'i Institute of Marine Biology, University of Hawai'i at MÄ□noa; Stephen Karl, Hawai'i Institute of Marine Biology*

In response to increasing anthropogenic and natural threats to coral reefs, scientists and managers are implementing resilient marine protected area (MPA) networks to increase the chances of reef recovery following disturbance. One of the key components of the design is connectivity. Although it has been difficult to understand patterns of connectivity in the marine environment, population genetics is becoming a promising tool. In this work, we use Palau's barrier reef as a case study to explore coral connectivity and provide advice for the design of their existing MPA network. Fifty colonies of Acropora hyacinthus were sampled at each of 25 sites around Palau's reef including in existing MPAs. We amplified 16 microsatellites with forward primers designed with an individual index for each colony

(n=50). All 25 sites were sequenced using Illumina MiSeq genome sequencer. A bioinformatics pipeline was created to assign each colony a genotype based on the 16 distinct microsatellites from which we could analyze nucleotide variants such as SNPs. The results of the sequences will give an insight on the relatedness of the colonies of Acropora hyacinthus around Palau's reef and coral connectivity at an island scale, providing guidelines for the design of resilient MPA networks.

The degradation processes and the complex methods of increasing productivity of irrigated ecosystems of the sierozem zone of Kazakhstan

Bekbayev, R.K. & Zhaparkulova, E.D. (Kazakh Research Institute of Water Management, Kazakhstan)

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Introduction to Symposium

Helen Regan

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Managing Beyond Protected Areas for the Conservation of Wildlife

Jason Hon, Policy Manager / Conservation Spatial Planning WWF Malaysia

Sarawak, a Malaysian state in Borneo, is rich in plant and animal diversity, and forms part of the global biodiversity hotspots. However, under its existing land use policy, only 8% of its 124,449km2 land mass is allocated for conservation as Protected Areas with only 4.8% gazetted to date. Furthermore, the existing protected areas are mostly small in size and occur in isolation, surrounded by various other land uses, exposing them to threats that can affect their ecological integrity. Conservation of wildlife cannot hinge solely on the roles of protected areas. With about 48% of land allocated as production forests, the long term existence of wildlife in Sarawak is dependent on how well these forests outside of protected areas are managed. Hence, production forests have important roles for the conservation of wildlife, albeit in sub-pristine environment. Results from a wildlife survey conducted in central Sarawak from 2010 to 2011 has shown that logging concession area under sustainable forest management practices could harbour rich faunal diversity. Using camera traps, eight ground dwelling mammal species that were listed as Vulnerable under the IUCN Redlist and three as Endangered were recorded. Altogether, 15 carnivore species were recorded. The Endangered Bornean bay cat Catopuma badia , was recorded in a logged-over site and along riparian buffers that have been set aside for conservation. Influencing how logging is carried out, and identifying key wildlife habitats within well-managed production forests, are imperative towards long term existence of wildlife in Sarawak.

Landscape Conservation Design Piloted in the Connecticut River Watershed

Scott Schwenk, North Atlantic Landscape Conservation Cooperative; Kevin McGarigal, UMass Amherst; Nancy McGarigal, U.S. Fish & Wildlife Service (USWFS); Andrew Milliken, USWFS; Randy Dettmers, USWFS; Jeff Horan, USWFS; David Perkins, USWFS; John Warner,*

The North Atlantic Landscape Conservation Cooperative (LCC), the U.S. Fish and Wildlife Service, and UMass Amherst led a collaborative effort in 2014-2015 to develop a landscape conservation design for the Connecticut River Watershed. The pilot effort is designed to serve as a demonstration for applying large-scale conservation design tools and processes supported by the North Atlantic LCC and other

regional partners. The design is intended to reflect the common priorities of governmental and nongovernmental partners working within the 7.2 million acre watershed and, ultimately, to guide shared conservation actions to protect, restore, and manage lands and waters to sustain the species and ecosystems of the watershed. Steps in the design process have included: 1) developing overall goals for ecosystems and for species of fish, wildlife, and plants; 2) combining concepts of ecosystem integrity and resilience with mapped landscape and ecosystem features to identify ecosystem priorities; 3) translating population objectives into habitat objectives for selected representative species of fish and wildlife; 4) incorporating scenarios of future climate change and development into the design; 5) combining ecosystem and species priorities into a unified network of core areas and connectors; and 6) mapping information about ecological values and priorities outside of the core area network. The design was developed through regular meetings of more than 30 conservation partners. Future steps include implementing and monitoring the design and extending the approach to other areas in the Northeast. More information is available at: http://northatlanticlcc.org/groups/connecticut-river-watershed-pilot.

Beyond resistance: applying landscape genetics to conservation and ecological problems

Clinton W. Epps, Dept. of Fisheries and Wildlife, Oregon State University; Jessica A. Castillo, Dept. of Fisheries and Wildlife, Oregon State University; Tyler G. Creech, Dept. of Fisheries and Wildlife, Oregon State University; Rachel S. Crowhurst, Dept*

Landscape genetic analyses are typically intended to resolve how landscape features influence gene flow among populations and movements of individuals. Thus, most analyses to date focus on deriving a resistance surface and testing hypotheses about barriers and habitat types that impede or facilitate movement. However, employing such analyses as tools in ecology and conservation requires additional consideration and is often not fully realized. We describe attempts to apply landscape genetic analyses to guiding conservation and management and exploring ecological questions. We demonstrate use of genetic-derived landscape resistance models in network analyses to prioritize managing connectivity in an anthropogenically-fragmented metapopulation of desert bighorn sheep, modeling impacts of climate change on species distributions for American pikas, inferring isolation of large herbivore populations in East Africa, evaluating potential for disease spread in bighorn sheep, and informing individual-based population models for American pikas. We discuss assumptions and difficulties with comparing and applying resistance models to ecological problems, and identify possible new directions for these applications.

ForSES: A social-ecological framework to guide the co-development and assessment of adaptation strategies to global change in the context of multiple-purpose forest management.

Clement Chion, ISFORT - Universite du Quebec en Outouais (UQO); Frederik Doyon*, ISFORT - Universite du Quebec en Outouais (UQO); Annie Montpetit, ISFORT - Universite du Quebec en Outouais (UQO)*

The emergence of unforeseeable states (surprises) is common in the dynamics of complex systems such as forests. Therefore, adapting forest management to global change is a matter of preparing stakeholders to address the uncertainties. In the case of multiple-purpose forests (MPF) management, such an adaptation process must account for the various and often conflicting stakeholders' interests with respect to different ecosystem services. Viewing MPF as social-ecological systems (SES), we propose the ForSES framework to foster local adaptation of forest management to global change based on 1) stakeholder participation and 2) modelling of projected impacts of future changes on forest ecosystem services. The ForSES framework focuses on feedback loops between both natural and human systems to structure and address problems at hand. Specifically, ForSES relies on the cartography of stakeholders' interactions with forest and resources such as their ecosystem services' preferred and

acceptable states along with their perceptions of social-ecological dynamics. During a series of workshops, ForSES is used to guide the co-construction by stakeholders and scientists of a conceptual model of a participatory simulation platform (i.e. serious game). This platform is designed to explore how stakeholders perceive and respond to risks related to scenarios of future changes (e.g. climate, development/management projects). Participatory simulations and debriefing sessions carried out with stakeholders are aimed at developing alternative scenarios of adaptation strategies to upcoming changes (i.e. both adaptation measures applied to the natural system and adaptive capacity enhancement measures applied to the human system). In the ultimate phase of the global approach, the co-constructed conceptual model under the ForSES framework can be used to develop an agent-based model (ABM) of the SES under study in the context of change. Such an ABM offers the opportunity to assess the alternative adaptation strategies co-developed by stakeholders during the previous phase. The ForSES framework along with its operationalization are presented in the context of a MPF in Quebec, Canada.

Forum on Landscape Conservation Design from the Managers Perspective

Louisa Evers, BLM; Charles Houghten, US FIsh and Wildlife Service; Cynthia WIlkerson, Washington Department of Fish and Wildlife

This Forum is part of a larger Symposium, "Landscape Conservation Design: Applications and Lessons Learned". This forum will be a one-hour panel discussion of how LCD products are being or intended to be used in management planning, and recommendations for future efforts. The panel discussion will involve each panel member describing their individual organizations interest in getting involved in a collaborative landscape planning effort. Discussion topics posed to the panel will revolve around: 1) expectations of engaging in landscape planning effort. e.g., what benefits to organizational planning and implementation are expected?; 2) What are some potential pitfalls or problems that have been encountered?; and 3) how are these efforts embraced across different levels of the organization, from field to line management.

Simulation of insect impacts on forest dynamics: Landsat defoliation maps predict growth declines in tree ring data

Jane Foster, University of Minnesota; Anthony D'Amato, University of Vermont; John Bradford, U.S.G.S - Southwest Biological Science Center*

Insect outbreaks that periodically defoliate temperate forests reduce growth and increase mortality over large landscapes. Effects of defoliation are often difficult to map because trees are resilient to a few years of stress, allowing them to rebound in terms of foliage and wood growth. This resiliency can mask changes in productivity that affect carbon uptake and storage, processes that are critical to understanding the global carbon budget. Recent advances in defoliation mapping from satellite data have allowed us to simulate insect outbreaks with more realistic spatial patterns and disturbance intensity. Yet satellite patterns have not been directly linked to concurrent field data that quantified growth effects. Here, we map annual defoliation in northern Minnesota from Landsat data 1987-2008 and relate defoliation to biomass changes in a large tree ring dataset in the Superior National Forest. An outbreak of forest tent caterpillar (Malacosoma disstria) in 2001-2002 allows us to quantify growth effects on deciduous host species including Populus tremuloides and Acer saccharum. For both P. tremuloides and A. saccharum, aggregate biomass growth declined significantly with increasing defoliation. Model coefficients agreed well with a review of plot-based defoliation-growth relationships that feed into disturbance extensions in Landis-II. By scaling the predicted growth effects from defoliation maps to host dominated forests, we estimate the magnitude of reduced growth caused by

the 2001-2002 outbreak across the Superior National Forest. This analysis will allow us to simulate insect outbreaks in landscape models with increasing realism.

Spatial measurement of natural and anthropogenic influences on organic soil C stocks

Jenny Farmer, University of Aberdeen; Charlie Langan, University of Aberdeen, The James Hutton Institute, Carbon Foundation of East Africa; Alessandro Gimona, The James Hutton Institute; Jo U. Smith, University of Aberdeen*

Wetland systems in south western Uganda experience a range of anthropogenic disturbances, principally through a number of different land management practices; including harvesting of papyrus vegetation and extensive ecosystem modification for potato cultivation. These wetland management regimes provide a diverse range of ecosystem services that are underpinned by the carbon rich organic soils that characterise these systems. Due to topography and other environmental factors, the organic soil properties (in particular carbon) likely vary naturally across a wetland system. In addition, within a single wetland system multiple land uses can be found that influence natural patterns of variability in soil properties, including interventions and management practices that both contribute and attempt to address issues of wetland degradation. The challenge, then, is to separate out the anthropogenic induced variability in soil properties from natural variability. The method developed in this study applies spatial sampling to a wetland system to evaluate the influence of environmental factors on soil properties, and then examines the more recent effect of anthropogenic activities on these. Additional to this, spatial mapping of the soil properties across the wetland system allows the impact on soil carbon of the location of current degradation and restoration land management practices to be evaluated. Simulations of the impacts of a variety of different wetland based activities on soil carbon, at different locations of the wetland will be examined, allowing spatially targeted interventions to be designed.

Perennial bioenergy crops in an industrial agricultural landscape: A landscape ecological approach in the North American Corn Belt

John B. Graham, University of Michigan; Joan Iverson Nassauer, University of Michigan; Qiuling Chen, University of Michigan; Bradford Kasberg, University of Michigan; M. Cristina Negri, Argonne National Laboratory; Herbert Ssegane, Argonne National Labor*

Federal agricultural and energy policy has increased areas of maize and soy cultivation in the American Corn Belt, in part to meet renewable biofuel standards. To date, annual crops have dominated domestic biofuel production. However, agencies including the U.S. Department of Energy (DoE) are currently examining the development of a bioenergy system based on perennial bioenergy crops (PBCs). PBCs will likely be grown in small patches scattered across an entire landscape, involving many different farmers and potentially enhancing biodiversity. Landscape ecologists have previously used alternative scenarios to explore the impact of agricultural policies, including on the Corn Belt. We use an alternative scenario framework adapted from prior research in the US, Europe, Australia, and New Zealand in order to develop plausible policy and technology scenarios and resulting future landscape patterns (FLPs) that incorporate PBCs within the Corn Belt agricultural matrix. As a result of this process, we developed four plausible, farmer-vetted FLPs as a basis for comparing alternative PBC policies and for exploring their impacts on ecosystem services, including pollination as measured by native bee habitat. Ultimately, our work informs the DoE about potential impacts of different bioenergy strategies related to policy choices that could affect American agricultural landscapes for decades. Our results also contribute to landscape ecology knowledge supporting development of more sustainable forms of agriculture around the world.

Crop mosaic composition and configuration differentially affect vegetation diversity in farmland

Audrey Alignier, INRA UR 0980 SAD-Paysage*

Landscape heterogeneity is widely recognized as a key determinant of biodiversity. Complex landscapes have been reported to benefit weed species richness at both local and landscape scales. But landscape heterogeneity was mainly associated with the proportion of semi-natural areas. Little is known about the effects of the crop mosaic heterogenity itself. Moreover, local environmental heterogeneity, partly created by different disturbance regimes, may also affect spatial variation of plant species composition. Our aims were to (i) analyze the independent effect of crop mosaic composition and configuration on vegetation richness and composition, (ii) examine whether changes occurred in vegetation richness and composition according to the field position (field centre vs field edge) and (iii) determine whether crop mosaic composition and configuration gradients modulate vegetation changes between field centre and edge. As part of the Farmland project, we sampled weeds in crop fields within 30 1km x 1km agricultural landscapes, in Brittany, France. We showed that landscapes with higher diversity in crop mosaic composition had higher vegetation diversity. Field edges had noticeably higher richness than field centres. Beta diversity between field centre and edge was positively related to crop mosaic heterogeneity supporting the role of spatial heterogeneity in maintaining plant diversity in agro-ecosystems.

Teaching social-ecological systems: VART curriculum development

Jelena Vukomanovic, INSTAAR - CU Boulder; Patrick S. Bourgeron, INSTAAR - CU Boulder; Chris Ray, INSTAAR - CU Boulder*

The mountain communities of the Colorado Front Range (COFR) are part of a landscape of interacting disturbances, including large fires, widespread insect outbreaks, and floods. Children in these communities have experienced first-hand the results of management and policy actions on the landscape. We had the exciting opportunity to collaborate with elementary school teachers in Jamestown and Gold Hill, CO, to develop a curriculum for introducing the key social-ecological systems concepts of Vulnerability, Adaptability, Resilience, and Transformability (VART). We began with in-class discussions about droughts, fires, insect outbreaks, flooding, and climate change, using tree cores and historic photos and objects to learn about the timings of these disturbances and how they relate to local history. Students engaged in scenario-planning using watershed models and maps and were encouraged to talk about the kinds of natural and built features that they would like to see in their towns. The ability to visualize different management scenarios introduces the idea of trade-offs and empowers students as future decision makers. We followed classroom activities with field exercises, including an opportunity to take tree-core samples and, with the assistance of local restoration experts, to embark on a small restoration project in a nearby riparian area. As scientists we also learned valuable lessons, discovering ways to re-frame management efforts as applied science, reflect on shared experiences and focus on empowerment, translate concepts for kids, and produce a lasting curriculum that can be built upon year after year.

Challenge of integrating landscape metrics as indicators of ecosystem services into regional planning

Susanne Frank, Christine Furst, -Center for Development Research, Department of Ecology and Natural Resources Management, University of Bonn, Germany; Frank Pietzsch, PiSolution GmbH*

The relationship landscape metrics - biodiversity - ecosystem services - regional planning is a promising, contemporary research field with high practice relevance. Much work has been done in the field of indicator development. The implementation into practice, however, still has big potential.

In this contribution we present a landscape metrics (LMs) based ecosystem services assessment approach. It facilitates standardized calculation, combination, and interpretation of a choice of landscape metrics and, hence, the evaluation of the impact of composition and configuration of land use patterns on biodiversity and ecosystem services. Different landscape ecological methods are combined, including ecological connection matrices, moving window approach, and cost-distance-analysis. As a result, landscape fragmentation, habitat connectivity, and landscape diversity can be assessed qualitatively. We focus on the assessment of ecological integrity and landscape aesthetics. The methodology was implemented in land use change simulation software and applied for decision-making in regional planning context.
Concluding, it is of great importance to consider landscape structural aspects in monitoring and assessing biodiversity and ecosystem services, especially in the context of regional planning. By using LMs as indicators, relevant planning information becomes tangible. Opportunities and limitations of the approach are discussed. For establishing a standardized application of LMs, a common methodology needs to be formulated.

West Nile virus foci are associated with landscape characteristics in a high-risk area of the north-central United States

Christopher L. Merkord, South Dakota State University; Paolla Giacomo, South Dakota State University; Lon Kightlinger, South Dakota Department of Health; Michael B. Hildreth, South Dakota State University; Michael C. Wimberly, South Dakota State Universit

West Nile virus (WNV) poses an ongoing public health risk in the United States, particularly in the northern Great Plains where South Dakota has the highest long-term WNV neuroinvasive disease incidence in the country. There is a need for better information on the timing and spatial pattern of WNV disease risk in order to allocate limited disease prevention and mosquito control resources with greatest efficiency. While previous studies have shown that WNV risk is related to ecological factors affecting mosquito ecology, avian host availability, and human activity, the landscape characteristics that facilitate virus amplification and transmission to humans are still poorly understood. Here we analyze the landscape characteristics that are associated with persistent foci of human disease across the state of South Dakota. We used a random forest model trained with georeferenced case data from 2004 to 2014. Covariates in our model included human population density, terrain and soil characteristics, and the 30-m resolution Landsat 7 top of the atmosphere reflectance data and spectral indices obtained from Web-Enabled Landsat Data (WELD) projects. We found ecological relationships with WNV risk at multiple scales, including regional climate gradients, sub-regional variability in physiographic settings, and local landscape characteristics related to land use and soil drainage. These results will be integrated into a WNV risk map that can be used by decision-makers at state and local levels to support more efficient distribution of resources for WNV prevention and vector control activities.

The expressing efficiency of landscape indices on mangrove heath status monitoring in Coastal mangrove wetlands

Yongguang Sun, Jing Kang,Yuanbin Fu,Xiu Su, Dongzhi Zhaoï€ª, Yang Gao, Baoquan Weiï¼ŒShugang Gao

Mangrove communities patterns were analyzed to identify their ecological significance through a quantitative analysis of mangrove community health and landscape pattern indices of several mangrove communities based on images from 1964 KH and 2010 SPOT5, with the help of remote-sensing classification, landscape pattern analysis and relevant statistical analyses, several mangrove wetlands were included in the study. Results show 1) the mangrove communities occur in zones ranging from the A.marina community along the coast in sequence inland with the A. corniculatum and K. candel communities and the R. stylosa community occurring in turn; 2) Leaf Area Index (LAI) of mangrove communities varied by the community type and increased along a gradient from ocean to land; 3) Patch Size Coefficient of Variance (PSCoV) and Number of Patches (NP) also increased along a gradient from ocean to land while Mean Shape Index (MSI) and Mean Patch Edge (MPE) exhibited an opposite trend with lower values found in the A. marina community and higher values in more inland regions with greater species richness; 4) Landscape pattern indices were correlated significantly with LAI, and the correlation coefficient ranged from negative to positive as follows: MPE > PSCoV > NP and MSI. The relationship between both of these was mainly affected by spatial differential features of each mangrove community. The author concluded that both time sequence and space sequence should be considered when evaluating mangrove landscapes, and certain landscape pattern indices of each species should be evaluated, rather than evaluating the entire mangrove community.

Urbanization and Landscape Changes in China: a case of six rapidly urbanizing regions

Weiqi Zhou

Over the past several decades, China went through a very rapid and magnificent urbanization process, which has dramatically changed local and regional landscapes. To fully understand the social and ecological consequences of these changes, it is crucial to first characterize and quantify its spatiotemporal pattern. This paper presents the results of the comparisons of the extent, rate, and spatial pattern of urban expansion, and associated ecological effects from 1980 - 2010 across six rapidly urbanizing regions in China, namely Beijing-Tianjin-Tangshan, Yangzte River Delta, Pearl River Delta, Chengdu-Chongqing, Wuhan, and Changsha-Zhuzhou-Xiangtan. We found: 1) there were dramatic increase in developed land for all of the six regions. The proportion of developed land increased the most in the Yangzte River Delta, from 4.12% to 21.85%, or an increase of approximately 20000 Km2. 2) the spatial distribution and temporal dynamics in urban expansion varied greatly among regions, as well as within each urban region, reflecting expedited urbanization in more recent years and the spatial shifting of development hotspots; and 3) urban expansion caused great loss of agricultural lands and increased fragmentation, reduction in biomass and NPP in urbanizing regions, serious air pollution and dramatic reduction in visibility in cities and surrounding regions, and intensified urban heat islands and form of urban heat "archipelagos". This study provides insights on the process of urban expansion, and its ecological consequences in China, and thus has important implications for urban growth planning and management.

Data-based approaches to modelling observed and future land-use change for Switzerland

Bronwyn Price, Swiss Federal Research Institute WSL; Felix Kienast, Swiss Federal Research Institute WSL; Irmi Seidl, Swiss Federal Research Institute WSL; Peter H. Verburg, VU University Amsterdam; Christian Ginzler, Swiss Federal Research Institute WSL

In Switzerland, the decreasing significance of agriculture has led to prominent processes of land abandonment in mountainous areas. At the same time, urbanisation in Switzerland is increasing at a rapid rate at the expense of other land use types, particularly open land agriculture. This research

defines 5 scenarios of future land-use for Switzerland along axes of Globalisation to Regionalisation and Market-driven developments to high policy intervention. This presentation focusses on methodological aspects including advantages and disadvantages of the approach. Using the Dyna-CLUE land use modelling framework and a data-driven approach we incorporate socio-economic and bio-geographical variables to model land use suitability and model scenarios of land use change for 2035. We examine the spatial variability in drivers of LULC and the explanatory power of regional versus national models. High resolution past LULC data is available for 1985, 1997, 2009 and model validation is a comparison of the fit of our model's simulated 2009 'land use model' to the independent 2009 observed data ('reference model') and to a 'random model' for 2009. Given our choice of high-resolution but nation-wide approach there are important implications for interpetation of results by decision makers, especially at the local to regional level.

Question & Answer

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Of time and tides: Climate change impacts to Pacific Northwest tidal wetlands

Laura Brophy, Estuary Technical Group, Institute for Applied Ecology*

How will tidal wetlands in the Pacific Northwest (PNW) respond to sea level rise and climate change? PNW tidal wetlands include low and high tidal marsh and "tidal swamp" - the latter including forested and scrub-shrub tidal wetlands. All of these wetland types have been heavily impacted by human alterations to the landscape, especially diking and drainage. Remaining and restorable PNW tidal wetlands have regionally unique characteristics and controlling factors that will mediate their climate change responses, including wide seasonal variation in inundation and salinity regimes; high soil organic matter content and likely high accretion and carbon sequestration rates; soil salinities ranging from strongly brackish to fresh; sheltered settings with low wave action and relatively low erosion risk; and active system engineers such as beaver and Sitka spruce (via its extensive root platforms). We will examine how these controlling factors will determine the biotic responses of PNW tidal wetlands to climate change; outline practical adaptation strategies to protect these vital resources; and discuss data gaps and research needs. The information presented will be drawn from our team's active monitoring program, including more than 60 tidal wetland restoration and reference sites on the Oregon coast, and our comprehensive "ocean to head-of-tide" assessments of estuarine wetland resources for the Necanicum, Nehalem, Tillamook, Yaquina, Alsea, Siuslaw, and Umpqua estuaries of Oregon.

Landscape patterns of Jiangsu coast under the coastline evolution since Song Dynasty

Fangfang Cai, Lijie Pu, School of Geographic and Oceanographic Sciences, Nanjing University*

The variation of coastal landscape pattern can provide key information of both natural and anthropogenic activities in regional ecosystem. Jiangsu coast has the largest coastal wetlands and tidal flats in China, and its landscape pattern is deeply affected by the massive reclamation activities since Song Dynasty. Previous studies mainly focused on the structure, transition and functioning of the landscape within fixed boundaries, disregarding the dynamics of coastline or tidal flats during the study period. This study aims to classify, map and characterize the landscape pattern of Jiangsu coast under the coastline evolution since Song dynasty. We firstly calculate the speed of coastline changes in each transact of Jiangsu coast, and divide the results into different speed ranges by summarizing the deposition and erosion rate. Under this division, the study area is classified as different speed sections,

like high-speed, medium-speed and low-speed section. Then, we analyze the structure, pattern and composition of the landscape by overlaying the speed sections with the land cover maps. In particular, the land cover is interpreted by distinguishing different intensity of reclamation activity and land use, i.e. "farmland, 30-years-old reclamation with cotton cultivation". Finally, the spatial determinants of the landscape are discussed by indicating strong associations between landscape patterns and a range of socioeconomic and biophysical indicators of human-environment interactions. The study is expected to propose a dynamic perspective for analyzing coastal landscape, and result in a more accurate representation of landscape patterns for the design of sustainable coastal land governance strategies.

Workshop 1: Techniques for eliciting multi-stakeholders decisional making mechanisms.

Clement Chion, Institut des sciences de la foret temperee, Universite du Quebec en Outaouais

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Cultural ecosystem services in a compacting city - case studies from Stockholm

Ulla Mortberg, KTH Royal Institute of Technology; Juan Azcarate, KTH Royal Institute of Technology; and Berit Balfors, KTH Royal Institute of Technology*

In order to reach a sustainable urban development, urban planning needs to simultaneously focus on energy and transport efficient cities, with low climate impact, that are still attractive and healthy for urban citizens, with a rich access to ecosystem services. To meet these needs, urban planning is increasingly focusing on compacting cities. However, when compacting cities attention is often paid to reach energy efficiency, while the preservation and enhancement of ecosystem services is frequently neglected, leading to an incremental loss of urban ecosystems. These urban ecosystems are essential for the provision of various ecosystem services, such as cultural ecosystem services (CES), which provide intangible benefits of importance for human well-being. For this reason, there is a need to improve knowledge as well as decision support tools concerning CES in urban planning in order for the topic to be included in urban compaction agendas on different planning levels. Such tools should also address the scale issues and mis-matches between administrative borders, planning agendas and ecological processes, including human use of urban landscapes. This study aims to explore the potential provision of and pressure on CES in a number of case studies within metropolitan Stockholm, consisting of several municipalities within which compaction planning is taking place. In this way, planning strategies for CES as well as knowledge gaps will be addressed and discussed in a comprehensive way, at local and regional urban planning levels.

Diets, trade, and the geography of global agricultural land use

Graham K. MacDonald, University of Minnesota; Paul C. West, University of Minnesota; James S. Gerber, University of Minnesota; Joseph P. Reid, University of Minnesota; Emily S. Cassidy, Environmental Working Group; Shipeng Sun, University of Illinoi*

Changing food consumption patterns have important implications for agricultural land use both within and across regions due to trade. Yet, the specific role of international trade as a component of global shifts in diets over time is less clear. We examine the relationship between agricultural trade and food supplies across nations by fusing bilateral trade statistics with national food balance sheets from the United Nations Food and Agriculture Organization (FAO) for the period 1993 to 2010. We then estimate the agricultural land base required to meet the annual caloric demand for different commodity groups in each country, including that derived from foreign imports. Growing global demand for specific commodities (e.g., oilseeds and 'luxury' foods), as well as more land-intensive animal products, has

coincided with the emergence of key export-oriented land-use systems. However, net-food importing nations differ considerably in the relative stability of their dietary sourcing over time, with evidence of both highly entrenched trade relationships (e.g., Japan) and abrupt inter-annual shifts in import patterns (e.g., Saudi Arabia). Our preliminary findings suggest that global food trade has facilitated changes in both the composition of diets and increases in total calorie supplies in many countries, with important effects on the distribution of agricultural land use across regions. We close by discussing examples of rapid transitions in land-use systems associated with dietary change and agricultural globalization from both food importing and exporting country perspectives.

Prioritizing North Carolina Streams Based on 247 Maxent-derived Predictive Habitat Maps of Aquatic Organisms.

Mark Endries, U.S. Fish and Wildlife Service

To better understand the spatial distribution of freshwater aquatic species in North Carolina, the U.S. Fish and Wildlife Service's Asheville Field Office created predictive habitat maps for 247 different aquatic species (using geographic information systems and maximum entropy modeling) and summarized these maps into a statewide prioritization of all streams. The maps were derived by comparing species occurrence information with a suite of stream- and landcover-derived environmental variables. The maps identify the predicted probability of suitable habitat conditions, by species, for each stream segment in North Carolina. To create a statewide prioritization of all streams in North Carolina, all 247 species maps were summarized using a weighted NatureServe global rank scheme. This scheme gives increasing weight to the greater levels of imperilment and species extinction risk as the global rank increases from G5 to G1. For each stream segment in the state, the global rank for each species predicted to be present was identified; the sum of the weighted global ranks for these predicted species was then calculated. For the resultant map, as the sum value identified for a stream segment increases it indicates the predicted presence of species with greater levels of species imperilment and/or greater levels of predicted species diversity. This prioritization map helps identify streams and watersheds in North Carolina based on predicted diversity and the predicted presence of globally rare species. The map facilitates the communication of this information with partners to assist with conservation planning efforts throughout the state.

Towards national mapping of aquatic condition (II): Predicting the probable biological condition of USA streams and rivers

Ryan A. Hill, ORISE c/o US EPA Western Ecology Division, Marc H. Weber, Scott G. Leibowitz, Anthony R. Olsen, US EPA Western Ecology Division*

The US EPA's National River and Stream Assessment (NRSA) uses spatially balanced sampling to estimate the proportion of streams within the conterminous US (CONUS) that deviate from least-disturbed biological condition (BC). These assessments do not infer BC at un-sampled streams, nor the anthropogenic stressors that degrade BC. A national map of probable (pr) BC could provide an important tool for prioritizing monitoring and restoration of streams. We used random forest modeling and data from 1,883 NRSA sample sites that were previously determined to have 'good' or 'poor' BC to predict prBC for ~5.4 million km of stream. The NRSA sites were linked to the Stream-Catchment (StreamCat) Dataset, which contains >100 natural and anthropogenic landscape metrics for ~2.7 million watersheds across the CONUS. prBC was best predicted (70% correctly classified) by 3 natural (elevation, air temperature, and sand content of soils) and 4 human-altered (% riparian naturalness, population density, and % of watershed composed of forest cover or agriculture) landscape metrics. We applied the model to the StreamCat dataset to predict prBC nationally. The national map of prBC provided a unique

assessment of model performance. Specifically, lower prBC was consistent with large-scale patterns of human-related land use. However, maps of local prBC were sometimes unrealistic, suggesting that predictions could be improved with regional, rather than national, models. Future work will seek to improve the national map of prBC for streams. In addition, our data and modeling framework will soon be extended to 356,044 lakes.

Modelling Landscape Conservation of Greater Sage Grouse in Relation to Oil and Gas Development

Richard S. Sojda, Computer Science Department, Montana State University, Bozeman; Robert B. Frederick, Department of Biology, Eastern Kentucky University; Matthew Heller, Greg Watson -Office of Landscape Conservation, USDI - Fish and Wildlife Service*

The effects of oil and gas development on the conservation of greater sage grouse (Centrocercus urophasianus) concerns wildlife managers. Effects of development are difficult to ascertain, a situation typical where cause-effect relationships are complex, multivariate, and involve landscape perspectives. Understanding the potential effects of development on grouse requires predicting where development is expected to occur on a landscape level. We gathered "reasonable foreseeable development" spatial data from the USDI's Bureau of Land Management that were available for Montana, North Dakota, South Dakota, Wyoming, and Northwestern Colorado. These data were disparate across the study area, and we standardized them across mapping units to establish consistent and quantitative categories. We describe the GIS processes used to accomplish that and to display the number of wells per township as projected in the BLM data. The data were then overlain with the priority areas for conservation for greater sage grouse. Our data, metadata, and data processing (standardization) documentation are available via the Landscape Conservation Management and Analysis Portal (LCMAP- https://www.sciencebase.gov/catalog/?community=LC+MAP+-+Landscape+Conservation+Management+and+Analysis+Portal). Using Bayesian belief network methods, we are modelling the relative spatial risk to greater sage grouse from oil and gas development based on the published literature. Risk analyses from site specific studies were linked to a conceptual model of the annual life cycle events of grouse. Using the density of the predicted number of wells, we present a regional-scale view of where the effects of development are expected to occur. The constraints to representing this in a spatial model using GIS are delineated.

Application of Landscape Ecology Design Metrics in Urban Green Infrastructure Planning: San Francisco, CA Case Study

Isaac Brown, Isaac Brown Ecology Studio

This presentation will review performance metrics and planning processes used to assess the ecological benefits of alternative green infrastructure program scenarios associated with the San Francisco Sewer System Improvement Program. The $6.8B program is currently in the planning phase and is scheduled to be implemented over a 30 year time frame. Green infrastructure interventions may exceed hundreds of acres with the potential to provide substantial habitat and other ecosystem services benefits in a biologically unique urban context. Metrics and planning processes designed to evaluate biodiversity, carbon cycling, and hydrological benefits for individual projects, watersheds, and comprehensive, city-wide program scenarios will be addressed. Biodiversity metrics measure landscape pattern, structure, and process characteristics relative to the existing condition and pre-European settlement landscape benchmarks. The presentation will address the empirical and logistical basis for chosen metrics, metric technical details, a multidisciplinary GIS-based assessment and reporting tool, and opportunities and challenges in applying landscape ecology principles within complex, multidisciplinary planning processes worldwide.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Application of LINKAGES Version 3.0 to Determine Tree Growth Potential in Response to Global Climate Change

William D. Dijak, USDA Forest Service, Northern Research Station; Brice B. Hanberry, School of Natural Resources, University of Missouri; Jacob S. Fraser, School of Natural Resources, University of Missouri; Hong S. He, School of Natural Resources, Unive*

Forest ecosystems change in response to climate and its interaction with soil resources. Changes in tree species abundance and distribution are expected as a result of global climate change. We updated LINKAGES 2.2 with new growth and mortality functions and used it to predict tree species growth in response to climate change based on tree species phenology and physiology. We incorporated spatially explicit daily weather and soil data as inputs into the mode to predict changes in potential growth of tree species over large geographic extents. We believe that this mechanistic process based modeling approach which accounts for seedling establishment, growth and competition for resources provides realistic insight into the relative growth potentials of many species within multiple communities. We verified model performance by comparing simulated tree sizes (DBH) with those recorded in U.S. Forest Inventory and Analysis (FIA) data. We simulated responses of individual tree species in each of the 600 land types across the Central Hardwoods Region and Central Appalachian Region of the United States under current climate and three climate change scenarios. We summarized data to demonstrate the utility of this model.

The demographics of primary and secondary traffic-related air pollution exposure in Portland, OR

Meenakshi Rao, Portland State University; Linda A. George, Portland State University; Vivek Shandas, Portland State University*

Human activity in urban areas leads to emissions of primary pollutants into the atmosphere. These primary pollutants react with other chemicals in the air, creating secondary air pollutants. Both primary and secondary air pollutants are harmful to human health. Due to their different modes of creation, primary and secondary air pollutants can have very different spatial distributions within a city. Consequently we can expect the demographic profile of the exposed population to be different for these two air pollutants categories. Although the spatial distribution of primary pollutants can be readily determined through proxies such as roads, the pattern of secondary air pollution is harder to determine. We measured NO2 and NO at 144 sites in Portland, Oregon using passive Ogawa samplers in summer 2013. NO is a primary air pollutant and a marker for anthropogenic combustion-related emissions. The ratio of NO2/NO is an indicator of the oxidative potential of the local atmosphere; therefore a strong indicator of secondary air pollution. Using the measured values of NO and NO2/NO, we develop land-use regression (LUR) models for primary and secondary air pollution in Portland. Using these LUR models together with ACS 2011 5-year data for age, education, and income at the block-group level, we determine the spatial distribution and profile of the vulnerable populations exposed to the highest quantiles of primary and secondary air pollution in Portland. Understanding the demographics of both primary and secondary air pollution can help planners develop more effective policies to address urban air pollution.

Why climate-change models need landscape ecology

Donald McKenzie, US Forest Service Robert E. Keane, US Forest Service Uma Shankar, University of North Carolina E. Natasha Stavros, Jet Propulsion Laboratory*

Global climate models (GCM), and other simulation models coupled to them, run at much coarser grid spacing (0.5Âº-3Âº worldwide) than are the typical domain for landscape ecology. In contrast, the spatial domains of landscape ecology, though varying from meters to hundreds of kilometers, are constrained by the need to represent critical processes, such as dispersal and contagious disturbance, spatially. These processes vary at much finer spatial scales than can be captured by Earth-system models, but that variability is critical to understanding their aggregate effects on the Earth system. Using a contagious disturbance (fire) as an example, we show how fine-scale variability in the landscape properties of fire regimes -- fuel and vegetation structure and species composition; topographic complexity; and local fire weather -- is the sine qua non of projecting regional effects of climate change. Important outputs, such as smoke emissions and transport and related feedbacks to the climate system, will be different from mean-field approximations at GCM scales. Because running landscape models at continental-to-global scales is logistically infeasible, we offer a process by which these models can serve as a "ground-truth" for those at coarser scales. By applying landscape models to selected sub-domains of larger models, representing different levels of fine-scale heterogeneity, we can estimate the errors associated with coarse-scale approximations of landscape dynamics by global- or regional-scale simulations. We can also identify appropriate parameters to serve as surrogates for fine-scale variation.

Plants as thermal refugia for desert birds: Evaporative water loss and high temperature extremes

*Thomas Albright, University of Nevada, Reno *; Sonia Heckler, University of Nevada, Reno;Denis Mutiibwa, University of Nevada, Reno*

Many desert-dwelling taxa must contend with thermal tolerances that are regularly approached or exceeded by high environmental temperature extremes. As such extremes become more frequent and severe under a changing climate, it is important to understand the fine scale spatial and temporal dynamics of temperature in order to more precisely understand the ramifications of these thermal tolerances. As an example of a biotic interaction, plants contribute to thermal regulation of birds and other animals by providing a more moderate microenvironment. Here, we describe research characterizing and quantifying the thermal environment of plant-mediated microsites in the hot desert environment of Kofa National Wildlife Refuge, Arizona. We deployed approximately 80 small temperature sensor/loggers at reference locations and at a range of microsites used by birds during hot conditions at four different sites. We then modeled evaporative water loss rates of a suite of 6 passerine birds. We found a substantial temperature offset in microsites surrounded by more dense vegetation. In particular, Desert Mistletoe (Phoradendron californicum), which was frequently used by breeding birds during hot months, was approximately 1.5 Â°C cooler than reference conditions during hot conditions. This small temperature difference resulted in more substantial changes in exposure to potentially lethal dehydration by reducing the period requiring active evaporative cooling and reducing the rates of evaporation. These results highlight the important thermoregulating role that plants play for desert avifauna and suggest that all factors that might alter temperature dynamics should be considered when assessing the impacts of a changing climate on biological conservation.

The Unintentional Consequences of Forest Policies on Disturbance Regimes

Christopher Bone, Department of Geography, University of Oregon; Cassandra Moseley, Institute for a Sustainable Environment, University of Oregon*

Fire processes in western North America share complex relationships with bark beetle outbreaks. While a recent surge of research focuses on the ecological impacts of one disturbance on the other, minimal attention is paid to the unintentional consequences that fire suppression policies have on beetle outbreaks, and, conversely, the effects of beetle mitigation policies on fire behavior. The goal of our

research project is to untangle how disturbance-related policies alter forests and their embedded disturbance regimes at both short and long time periods and from stand to landscape scales. Specifically, we examine how a century of federal and state-level policies that aim to reduce the impacts of fire tangle with conservation and harvesting policies to alter forest composition in a way that has significant consequences for beetle outbreaks. We explore the likelihood that the forest policy history has unintentionally created a highly susceptible forest across most of the western United States, which, coupled with the impacts of climate change, has led to the largest bark beetle outbreak on record. Our findings suggest that the future development of policies consider the coupled relationships between multiple disturbances when determining effective mitigation strategies.

Coalescent model selection takes the chaos out of seascape genetic analysis for a coral reef community

Eric Crandall, Hawaii Institute of Marine Biology; Rob Toonen, Hawaii Institute of Marine Biology; Kim Selkoe, Hawaii Institute of Marine Biology & NCEAS*

Seascape genetics holds great promise for illuminating the basic metapopulation structure of marine species: a prerequisite to deeper understanding of marine ecology and evolution. However, progress on this problem has long been hindered by a high number of migrants exchanged per generation among marine demes (relative to well-studied terrestrial systems). Relatively high gene flow in marine species leads to large effective population sizes and concomitantly high genetic diversity, which in turn tends to depress F-statistics traditionally used to measure genetic structure. Moroever, the island model of gene flow under which these statistics are often interpreted provides an additional cognitive obstacle to understanding marine metapopulation structure. We address these issues by using a coalescent model of gene flow to re-examine an extensive population genetic dataset of 33 species collected across the Hawaiian archipelago. In contrast to F-statistics, coalescent models make full use of information from high nucleotide diversity in marine genomes and may be used to test specific spatial hypotheses in a model selection framework. Our coalescent reanalysis finds evidence for stepping-stone dynamics along the Hawaiian archipelago (i.e. genetic exchange only among neighboring populations) in 19 of the species examined, as opposed to 4 species for which stepping-stone dynamics were inferred with F-statistics. Reciprocally, the number of species showing evidence of regional isolation decreased from 20 to 13. These results, which I will elucidate further in my talk, are in better agreement with our understanding of how larval dispersal processes structure marine metapopulations.

Future wildland fire, sedimentation, and a potential ecosystem service vulnerability in the American West

Jason Kreitler, WGSC, USGS; Joel B. Sankey, SBSC, USGS; Todd Hawbaker, GECC, USGS; Jason McVay, Northern Arizona University; Nicole Vaillant, WWETAC, USFS; Scott Lowe, Boise State University;*

Under a changing climate, there is an expectation of increased wildland fire activity and severity in the American West. A primary threat to socio-ecological systems in this region from wildland fire, and subsequent post-fire sedimentation, is the decline or disruption of watershed-based ecosystem services, such as the maintenance of water quantity and quality from forested catchments. However the spatial and temporal heterogeneity of expected fire, sedimentation, and water supply are all functions of changing climate and land use conditions. To estimate the magnitude of potential effects, we model expected post-fire sedimentation across the West at the HUC-8 level, using the InVEST Sediment Retention Model. We evaluate the accuracy and uncertainties for InVEST predictions using measured post-fire sedimentation rates available for many watersheds throughout the western USA from an existing, large USGS database of post-fire sediment yield. With our validated model we then push

estimates into the future using a USGS dataset of expected fire modeled according to IPCC SRES scenarios. With these estimates we illustrate how changing fire frequency, severity, extent, and location could affect watersheds and the ecosystem services they supply to western communities. The ultimate goal of this work is to assess the variability in post-fire sediment yield, and determine if targeted forest management practices could influence fire activity and potentially reduce ecosystem service vulnerability under a changing climate.

Mapping and assessing the cultural and social dimensions of ecosystem services

Veerle Van Eetvelde, Department of Geography - Ghent University, Belgium; Maria Valles-Planells, Department of Rural Engineering - Universidad Politecnica de Valencia, Spain; Hanne Van den Berghe, Department of Geography - Ghent University, Belgium; Fran*

The ecosystem service approach has proved to be successful to measure the contributions of nature to human well-being. But also landscape, as a broader concept, is responsible of supplying different services, including more cultural and social ones. Thus, the landscape approach is more appropriate to integrate natural and cultural aspects as well as the involvement of stakeholders. This paper focuses on the cultural and social services supplied by urban open spaces like public squares and green spaces that are contributing to the green infrastructure of the build environment. The objective of the paper is twofold. First, a method is designed to map and identify cultural and social services in different types of urban open spaces. Second, the relations between the supply of services, the landscape qualities, as well as the socio-demographic and geographical context of the areas are assessed. The study is performed in 14 urban open spaces exemplary for different types of services and social profiles of users in two European cities: Ghent (Belgium) and Valencia (Spain). The landscape services of these public spaces are mapped combining expert knowledge and user's perceptions. For the latter, a survey was compiled to collect the different degrees of supplies and demands of the services of the areas. The collected data was analysed qualitatively as well as quantitatively. The results can give input on how landscape services can contribute to human well-being in an urban context and to the application of this concept in landscape management and design of public open spaces.

Effects of a Large Infrequent Flood Disturbance on Cottonwood Forests along the regulated Missouri River

Christopher L. Merkord, South Dakota State University; Mark D. Dixon, University of South Dakota; Christopher J. Boever, University of South Dakota; Victoria Danzeisen, University of South Dakota; Michael L. Scott, University of South Dakota and Utah Sta*

Decades of flow regulation have altered the floodplain forests along the Missouri River, contributing to declines in plains cottonwood (Populus deltoides) recruitment, a predominance of older forest age classes, and increases in invasive woody (e.g., eastern red-cedar and Russian olive) and herbaceous plant species. Record runoff in 2011 led to the highest discharge in 59 years, with flood durations of up to 3 months. We assessed the impacts of this "large infrequent disturbance" by evaluating pre- (2006-2009) to post-flood (2012-2014) changes in riparian vegetation and land cover along six study segments spanning 1090 km of river. Shrub/sapling live stem density declined across all segments and most age classes, while declines in tree density were weaker and more variable. Declines in both were highest in the youngest stands (i.e., those that established after high flows in 1997). Sandbar area increased sharply and area of young forests declined. Post-flood cottonwood recruitment was widespread, but prolonged high flows in the summer of 2011 limited most recruitment to low sandbar positions within the active channel in 2012. On the Fort Peck segment in Montana, however, receding flood levels in June-July provided opportunities for recruitment in 2011 at overbank positions. Long-term legacies of

flow regulation and operational constraints within the regulated Missouri River limited the restorative effects of the 2011 flood and are likely to limit future forest recovery.

From monocultures to mixed-species forests: is tree diversity key in providing ecosystem services on a landscape scale?

Laura Schuler, Harald Bugmann, Rebecca Snell -Forest Ecology (ETH Zurich)*

Ensuring the provisioning of ecosystem services (ES) from forests is crucial, especially in the context of climate change and changing disturbance regimes. Converting monocultures into mixed-species stands appears to be a promising approach to warrant productive and resistant forests for the future. However, the importance of species composition, mixture levels and age distribution is still unclear. We assess the potential of different tree mixtures for provisioning a range of ES at the stand and landscape scale using the dynamic forest landscape model LandClim. Due to their importance in mountain regions, protection from natural hazards such as avalanches and rockfall, productivity as well as biodiversity aspects are examined. Depending on site conditions and thus landscape heterogeneity, monocultures or mixed-species stands are better able to provide certain EGS. With respect to landscape planning, our approach supports the evaluation of trade-offs between different ES such as timber production vs. avalanche protection. Furthermore, the model framework provides the opportunity to estimate the impact of climate change and disturbances, and how species mixtures can be used to cope with these challenges.

The signal of biogeography on the structure of global interaction networks

Dominique Gravel, Universite du Quebec Ã Rimouski; Camille Albouy, Universite du Quebec Ã Rimouski; Timothee Poisot, Universite de Montreal

Integrating network theory to biogeography is among the most important and exciting challenges that macroecologists are currently facing, yet the idea that species interactions have a biogeographical structure of their own is often overlooked. Achieving this integration is necessary to progress towards understanding species interactions through time and space, and doing so to predict species geographical distributions and community dynamics. The challenge is however quite high given the amount of work required to measure species interactions in the field. Moreover, traditional field-based approaches to reconstruct networks cannot be used to assess the interactions between species that actually never co-occurred but are likely in novel communities. We propose a quantitative framework to infer the structure of local interaction networks. We start from the observation that local interaction networks are never simple random samples of a regional and stationary meta-network. We then develop a probabilistic approach to infer interactions in this meta-network, accounting for species traits, co-occurrence and phylogenetic relationships. We apply this framework to the network of trophic interactions among pelagic and benthic fishes of the oceans, at the global scale. We find, not surprisingly, that spatial variation in community composition is the first factor responsible for the spatial variation in network structure. This variation is not random however, it is strongly driven by species-specific responses to variation in the environment. Secondly, we find a strong signature of biogeography in the global network of fish interaction. The framework we propose has potential practical implications such as the proposition of sampling guidelines for the inference of network structure, development of species distribution models accounting for biotic interactions and scenarios of future community structure following global changes.

Experiences of and challenges for landscape ecology research in Europe

Teresa Pinto-Â-â€Correia, ICAAM -University of Ã‰vora, Portugal; Marc Antrop, Department of Geography â€Ghent University, Belgium; Jesper Brandt, ENSPAC â€Roskilde University, Denmark; Lone SÃ¸derkvist Kristensen, Department of Geosciences and Natural

Landscape research faces important challenges today due to political, societal and environmental changes. In Europe, changing perceptions of landscape by policy makers and the public, as well as changing expectations of the role of academia, are affecting the approaches within landscape research. In this paper, we aim to present an overview of the experience of researchers and practitioners working with landscape in different European regions. We focus on three themes. The first theme considers the focus of the landscape research in the regions, as well as the perspectives and dominant approaches that are used e.g. ecology, biodiversity, heritage, perception, multifunctional land use, dynamics, planning. It also considers the balance between holistic, humanistic and parametric approaches and the degree of transdisciplinarity. The second theme assesses how societal and environmental processes at multiple scales together with changing perceptions influence and are influenced by landscape research. The third theme explores how the personal experiences of researchers relate to the key messages of landscape ecology in Europe as described in the paper 'How Landscape Ecology Can Promote the Development of Sustainable Landscapes in Europe - The role of the European Association for Landscape Ecology (IALE-Europe) in the 21st century' (Landscape Ecology, vol.8, issue 8).

Data and method dependence of soil carbon stock estimates and their consequences for the assessment of land use change

Laura Poggio, The James Hutton Institute - Aberdeen (Scotland, UK); Alessandro Gimona, The James Hutton Institute - Aberdeen (Scotland, UK)*

Both climate change and land use change affect soil carbon stocks at the landscape level. In Scotland climate change is likely to result in improved conditions for agriculture and, in some scenarios, intensification will be a key driver for changes. With a time horizon of 75 years, we modelled changes in soil carbon stocks under different land use and climate change scenarios in the north east of Scotland. We also investigated the effect of using approaches with different spatial resolution (including depth) to model carbon stock changes. The results highlight the importance of land use and spatial resolution for understanding stocks and flows of carbon in future landscapes.

Remote sensing and landscape ecology of beneficiary insectary habitat for agro-biodiversity conservation

Stephen K. Ndzeidze, Paul Jepson, Gwendolyn Ellen - IPPC, Oregon State University, Corvallis OR*

The spatial extent and structure of insectary habitats within cropped areas determines ecological services provision, including pollination, insect predators and parasites. These services can play a major role in conservation biological control. We are among the first to report using remote sensing and landscape ecology techniques to characterize the ecosystem services deriving from beneficiary flowering insectary habitats. Our very high resolution, ground level remote sensing protocol provided a quantitative assessment of spatial relationship and habitat distribution of insectary plantings across agricultural field boundaries. We documented density, cover, and diversity on the ground over time, and identified zones of influences of insectary patches, hedgerows and insectary row strips. We also characterized biophysical attributes such as healthy growth, blooming percentage cover, bare ground, litter and distinct vegetation structure, or dense and sparse vegetation cover. We conducted two case studies, at USDA-NRCS Plant Materials Center (PMC), and Persephone farms in Willamette valley Oregon. The Persephone farms contained patches installed by the farmer using expert knowledge with

the goal of harboring beneficial insects. We demonstrated that the patches installed by the farmer generated the greatest potential areas of beneficial influence within the planted crops, compared with the two linearly planted strips. These results comparing specific conservation practices, including hedgerows and in-field insectary strips, and the configuration and numbers of insectary plantings across whole farms, will lead to decision support tools for farmers interested in the design of beneficiary insectary patches, hedgerows and in-field insectary strips.

Decoding meaning in animal soundscapes: Dynamic and functional infoscapes of birds in family Paridae

Kathryn Sieving, Aaron Grade, Harrison Jones - University of Florida; Todd Freeberg, University of Tennessee; Jeffrey Lucas, Purdue University*

Paridae (titmice, chickadees) are vocally complex birds. Widespread and locally abundant throughout Holarctic woodlands, parid vocalizations encode situationally-specific information about predation risks used by diverse species to reduce risks in decision making. Parid soundscapes therefore encode 'infoscapes' of high survival value. We examine causes of variation in parid infoscapes in two pilot studies: a description (complete) and a manipulation (ongoing) of spatiotemporal variation in informational vocalizations. We present past works 'decoding' information in parid calls, pilot methods, and extraction of vocalizations from automated recordings using supercomputer-based spectral imaging. Descriptive data suggest that overtly public social calls identifying specific threats are spatiotemporally rare while contact notes encoding more generalized risk perception are produced near-continuously. Experimental manipulations are predicted to generate numerous social calls near playback stations that encode precise identifications of risks represented by playback treatments. Preliminarily we conclude that parid infoscapes are comprised of spatiotemporally widespread contact notes with lower threat specificity conveying a general titer of risk perception, punctuated by localized peaks of overtly public social calls conveying precise, accurate information identifying high-level risks. As keystone 'community informants', Paridae provide an informational response surface (infoscape) with dynamically updated, spatiotemporally detailed social information of high importance in animal communities.

Small Scale Variability in Snow Accumulation and Ablation Under a Heterogeneous Mixed-Conifer Canopy

Eryn E. Schneider, University of Montana; Andrew J. Larson, University of Montana; Kelsey Jencso, University of Montana*

The relationship between forest spatial patterns and snow hydrology is poorly understood. The spatial patterns of snow accumulation and ablation in forested watersheds directly control runoff generation processes and the annual quality and quantity of available water to downstream receiving waters. Forest canopies exhibit heterogeneity manifested as a mosaic of differing species, spatial arrangements, and canopy densities that differentially intercept precipitation and absorb or reflect radiation; controlling the processes of snow accumulation and ablation. Here, we investigated how spatial patterns of snow depth, density, snow water equivalent (SWE), and disappearance date (SDD) varied within stands of heterogeneous canopy structure. We collected 780 empirical measurements of snow depth, density and SWE at peak accumulation on two fully georeferenced, mixed-conifer plots in western Montana. Throughout the 49 day melt season, we monitored SDD, depth, and SWE every third day with 4900 samples per campaign. In 2014, snow depth, density, and SWE ranged from 0-67.31 cm, 5.43-49.76%, and 0.75-17.90 cm, respectively. A canopy competition index ranged from 0-86.8; non-forested areas averaged 11.5 cm SWE, melting around day 41 compared to mature dense canopy with average

SWE of 5.1 cm and a SDD near day 9. This preliminary work suggests a strong linkage between canopy structure and snowmelt processes. In the future we seek to link canopy patterns to the specific physical mechanisms that lead to differential snow dynamics in forested landscapes. This understanding is essential for improving process-based models and tools for forest managers to optimize forest water resources in a changing climate.

Spatial Scaling of Biodiversity in Agricultural Landscapes

Thomas O. Crist, Institute for the Environment and Sustainability and Department of Biology, Miami University, Oxford, OH; Valerie E. Peters, Institute for the Environment and Sustainability and Department of Biology, Miami University, Oxford, OH; Kaitli*

The biodiversity of plants and animals in agricultural landscapes may be strongly influenced by the size and spatial arrangement of land-cover types. Over the past 15 years, our lab has studied the variation in species diversity and composition of arthropods, plants, and other taxa in forest remnant and conservation grasslands surrounded by intensive agriculture in SW Ohio, USA. The diversity of most taxa is only weakly related to habitat area of forests remnants or conservation grasslands and strongly dependent on habitat edges or surrounding land uses, resulting in idiosyncratic patterns of farmland biodiversity among taxa. Nonetheless, aggregate measures of species richness and composition as measured by alpha and beta diversity show consistent patterns across taxa and spatial scales, with the alpha component within habitats explaining about 25% of the total landscape richness and the remaining 75% due to the beta component among habitats. The "dominance of beta diversity" hypothesis is also supported through analyses of 175 data sets from fragmented and island habitats. Several alternative explanations for these general patterns are explored, including the effects of variation in remnant habitat quality, land-cover diversity, and stochastic sampling of the larger species pool. To test these alternatives, Hierarchical Bayesian models of species distribution and abundance are used to determine habitat and landscape predictors of alpha and beta components of diversity in agricultural landscapes. Extensions of this approach could be used to predict variability in functional diversity or ecosystem-service providers in agricultural landscapes.

On the importance of non-linear relationships between landscape patterns, richness in species and the sustainable provision of ecosystem services

Sven-Erik Rabe, ETH Zurich; Adrienne Gret-Regamey, ETH Zurich*

Marginal land use changes can abruptly result in non-marginal and irreversible changes in ecosys-tem functioning and the economic values that the ecosystem generates. This challenges the tradi-tional ecosystem services (ESS) mapping approach, which has often made the assumption that ESS can be mapped uniquely based on land use and land cover data. Using a functional fragmentation measure, we show how landscape pattern changes might lead to changes in the delivery of ESS. We map changes in ESS of dry calcareous grasslands under different land use change scenarios in a case study region in Switzerland. We selected three ESS known to be related to species diversity including carbon sequestration and pollination as regulating values and recreational experience as cultural value, and compared them to the value of the two production services food and timber production. The fragmentation measure calibrated in the field shows the effects of isolation and fragmentation on species richness, and can be interpreted as the variability of community composition dependent on size, shape and configuration of the ecosystem. Results for the different scenarios show that the current unceasing fragmentation is particularly critical for the value of ESS provided by species-rich habitats. The study demonstrates the importance of inte-grating spatial measures such as fragmentation into ESS assessments. Mapping ESS without consid-eration of thresholds over space and time can lead to strong

overestimations of ESS. We conclude that assessing landscape patterns is key for maintaining valuable ESS in the face of human use and fluctuating environment.

Part II: Bridging gap between landscape assessment and strategic planning/application; Introductions: Outline of the session and expectations

Henry N. N. Bulley, Borough of Manhattan Community College, City University of New York

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Three-dimensional visualization as a science-based tool for assessing future ecological landscapes and for supporting management decisions: Example from a Mediterranean Nature Park in Israel

Liat Hadar, Ramat Hanadiv Nature Park; Jochen Mulder, Lenne'3D GmbH; Agnes Kirchhoff, Lenne'3D ; Avi Perevolotsky, Volcani Center, ARO; Yagil Osem, Volcani Center, ARO*

What might the future landscape look like? Which factors will shape it and what influence will managers and planners have on these processes? Will the landscape be "right" or desirable, and if so - for whom? These questions can be addressed by means of a 3D visual landscape model through which major landscape-shaping processes, such as wildfire, drought or species invasion can be communicated to mangers, decision makers and the general public. Scientific knowledge and ecological data describing vegetation processes (species composition, cover, height, spatial pattern) were used to create a highly realistic, dynamic model, that visualizes the future landscape under different management scenarios in a Mediterranean park. The model focuses on pine colonization, a management challenge relevant to many areas in the Mediterranean Basin. Based on numerous GIS layers, LiDAR, satellite imagery, and field quantitative datasets representing over 25 years of research it envisions the visual significance over decadal time scales of management alternatives such as selective or complete pine removal, grazing cease, post-fire treatment and doing nothing ("letting nature take its course"). The model can help mediate between objective landscape features and their perception by different audiences and promote discourse-based sustainable management.

Use of treated wastewater for the development of dryland- possible hazards

Owusu Kwaku, Ampa Resource Foundation Ghana, Joseph Okyere Dry land Development Center Egypt

Allocation of water to dryland rgions for the purpose of increasing agricultural productivity is not free risk.Intensive cultivation may degrade soil structure, weaken aggregate stability, and decrease soil organic matter(OM) content,all of which may , in turn increase the possibility for development of runoff and erosion.The use of treated wastewater(TWW)for irrigation could increase the likelihood for and the magnitude of aforementioned occurrances,because of the higher loads of OM and levels of sodicity and salinity in this water compared with freshwater.The adverse effects of irrigation with TWWare expected to take place not during the irrigation season,but rather during winter when the soilis exposed to rain water(i.e ,water without electolytes), which increases the sensitivity of the soil clays to the processes of aswelling and dispersion. In the currentpresentation we summarize recent data, obtained on clay and sandy clay soils,which indicated the bothdegrees of tillageand irrigation with TWWaffrected a number of soilphysical properties and the content and characteristics of soil OM.The relationship between the changes in the physicalparameters and those in the OM was not consistent. Concerning the impact of tillage , trend was noted whereby high levels of aggregatestability and saturated hydraulic conductivity were associated with the presence in the soil of young highly aliphatic OM(non-cultvated TWW-irrigated

soil). In the case of TWWapplication,no conclusive trends could have been detacted as the relationship between soil physical perimeters and those of the OM depended on the type of soil and tillage. Based on those observations , it is therefore recommended that caution should be taken when introducing the use of TWW for irrigation in newly cultivated drylands soils and that change in indices reated to soil structural stability and OM content and characteristics should be closely monitored to ensure sustainable crop production in the newly cultivated fields.

Human footprint and vulnerbaility of protected lands and natural communiites in conterminous United States

Neelam Poudyal, University of Tennessee; Duncan Elkins, University of Georgia; Nate Nibblink, University of Georgia; H. Ken Cordell, USDA Forest Service*

Many of the natural landscapes in the United States have recently seen significant expansion of human footprint, a collective term to describe population growth and land use change. Moreover, projected variation in climate change is likely to exacerbate the impact of these changes across the nation. Whether and where the stress of one or more of these changes will likely to take place, and how that might relate the distribution of protected and endangered natural ecosystem becomes important question to better prepare for mitigation, restoration, and management.This study first employed a geostatisical analysis on projected data on climate change, population growth, and loss of natural land at county level, to locate the hotspots of change , and then combined those hotspots with the layers of threatened and endangered (T&E) species, protected areas, and human communities to compare the characteristics between communities that belonged inside and outside the hotspot. Results show that a lot of changes will take place in and around protected lands and habitats of T&E species, and suggest that existing protection efforts may not be enough. Findings suggest need for climate education, smarter landuse plans, and climate education in communities that are projected to be in hotspots of change.

Assessing the stability of annual temperatures for different urban functional zones

Ranhao Sun, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences; Liding Chen, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences

The urban functional zone (UFZ) is the basic unit of urban planning, which is defined as an area of similar social and economic functions. Despite the importance of UFZs, the stability of their annual temperature between winter and summer has seldom been investigated. With an understanding of the thermal impacts that planning decisions can have, it is essential to know how UFZs can be designed to regulate temperatures in the urban environment. UFZs were identified using ALOS images in 2009 in Beijing. Land surface temperature (LST) was extracted from daytime Landsat TM and ASTER images. The regional LST variation of 31 district-sized sub-regions was correlated to the types of UFZs in the region and structural features of the region such as area, size, diversity, complexity and connectivity. Results showed that: (1) UFZ types, in order from highest to lowest LST variation, were commercial, campus, high density residential, water, recreational, low density residential, road, preservation, and agricultural zones; (2) the regional LST variation was positively correlated with the area of campus, commercial, high density residential, water, and road zones, but negatively correlated with the area of agricultural and low density residential zones; (3) increased connectivity and complexity decreased regional LST variations.

The results indicated that the stability of annual temperatures was determined not only by the UFZ type and size but also by the connectivity and complexity. These results are clearly useful and essential pieces of information that can be applied in urban planning to improve climate adaptability.

Eye tracking and landscape: Why insights in behavior is of importance to the future of landscape planning.

Johan Pihel, Swedish University of Agricultural Sciences*

The work presented here is a summary of a PhD-thesis on visual attention and how it is affected by tree retention and other landscape events in assessments of landscapes. The thesis is a compilation of four papers, all dealing with human visual perception during landscape assessments. Eye tracking is used as a method in all papers, and one of the goals of the thesis was to evaluate and evolve the methods usage in learning more of how participants behave when undertaking in landscape assessment tasks. The thesis investigates differences between experts and novices in ecology making biodiversity assessments, how water influences attention during assessments, in what way computer visualizations differ from photographs when it comes to eye movements and behavior and how projection of forest growth affects attention and assessments. The conclusion of the thesis is that, used correctly, eye tracking methods can give us valuable insights in human behavior and provide us with data that shows differences where we, by the means of conventional landscape assessment methods, miss out on information that can be critical when it comes to human evaluation or assessment of landscapes.

Litter-dwelling Ant (Formicidae) Response to Surrounding White-tailed Deer (Odocoileus virginianus) Densities and Landscape-level Amur honeysuckle (Lonicera maackii) Cover in Eastern Deciduous Forest

Michael B. Mahon, Department of Biology Miami University; Dr. Mary C. Henry, Department of Geography Miami University; Dr. Thomas O. Crist, Department of Biology Miami University

The overabundance of white-tailed deer (Odocoileus virginianus) and an invasive shrub, Amur Honeysuckle (Lonicera maackii) have strong effects on ecosystem processes in the eastern deciduous forest of North America. The impacts of deer and honeysuckle on forest understory plant communities are well known, but few studies have examined how they alter litter-dwelling invertebrates and soils. Ants (Formicidae), in particular, play key functional roles in forest ecosystems, acting as ecosystem engineers, predators, and seed dispersers. Changes to ant abundance and richness can have cascading effects on various ecosystem processes. We examined how the responses of ant communities to long-term deer exclosure and honeysuckle removals related to deer and honeysuckle densities in the surrounding landscape in remnant deciduous forest of southwestern Ohio. Ant species richness, composition, and abundance were sampled and analyzed from five deer 20x20-m exclosures paired with control plots, each with a split-plot removal of honeysuckle. Deer densities in the landscapes surrounding the experimental plots were estimated using distance sampling methods and landscape-level honeysuckle cover was estimated using Landsat imagery. We found that ant richness and abundance in the control plots tended to increase with increasing deer densities, but ant richness and abundance in the exclosure plots had mixed responses to increasing deer densities. These results provide evidence that landscape-level variation in deer overabundance and honeysuckle invasion have local negative impacts on biodiversity of leaf litter ant communities, which, in turn, may have cascading effects on forest ecosystem functioning.

Insights into the potential interactions of forest management and climate change from landscape modeling of the Two Hearted River watershed, Michigan USA

Jessica Price, University of Wisconsin at Madison; Janet Silbernagel, University of Wisconsin at Madison*

Broad scale conservation and management often involve multiple strategies applied across the landscape. However, the outcomes of such strategies remain difficult to evaluate given the interactions between natural ecosystem dynamics, resource extraction, climate change, and shifting land tenure trends. Planning and adaptive management efforts could benefit from insights into possible landscape futures to reduce the costs and minimize potential risks of implementing new strategies. The Forest Scenarios Project developed and applied an approach to collaboratively generate, model, and analyze alternative scenarios of forest management and climate change impacts using the VDDT/TELSA modeling suite. We applied this approach in the Two Hearted River watershed in the Upper Peninsula of Michigan, USA. Here, we discuss the ways climate change impacts influenced the outcomes of alternative management strategies for landscape composition and configuration and affected their ability to achieve conservation goals in the watershed. For example, increased occurrence of wildfire and windthrow events associated with climate change may negate the positive effects of cooperative ecological forestry practices on landscape connectivity. We also discuss how these results contribute to a larger effort to help land managers and conservation practitioners understand and effectively address the potential interactions between management decisions and climate change impacts.

Incorporating Eco-Evolutionary Processes into Population Models: Design and Applications

Jennifer M.W. Day, University of Washington; Nathan H. Schumaker, Environmental Protection Agency*

Eco-evolutionary population models are powerful new tools for exploring how evolutionary processes influence plant and animal population dynamics and vice-versa. The need to manage for climate change and other dynamic disturbance regimes is creating a demand for the incorporation of eco-evolutionary dynamics into both empirical studies and simulation models. Here, we discuss the salient features of eco-evolutionary population models and explore their potential for contributing to landscape genetics, conservation biology, and evolutionary ecology. We draw examples from our own work, and from that of our symposium co-authors, whose research ranges from theoretical to highly applied, and spans a wide array of life histories from pikas to elephants.

Part I Closing Discussion: Ensuring consistency and compatibility among different scales to monitor land use dynamics to mitigate "leakage" effects (Land-Use Change / Displacement Effect)

Moderator - Henry Bulley
Discussant - Felicia Akinyemi (Botswana International University of Science and Technology, Botswana)

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Calibrating forest landscape models: the challenge of model structural deficiencies

Bjoern Reineking, Irstea; Florian Hartig, University of Freiburg*

Recent computational and conceptual advances allow drawing statistical inferences for stochastic simulation models such as forest landscape models (Hartig et al. 2011).

These approaches are attractive, because they promise to quantify uncertainties in model parameters and to then propagate these to uncertainties of model predictions.

A key challenge of these approaches arises from the underlying assumption that the fitted forest model is structurally correct. Typically, however, models have structural deficiencies. If unaccounted for, model

outputs with strong bias can deteriorate model predictions, leading to bias and underestimation of uncertainty. In hydrology, one suggested approach to the problem is the use of informal likelihoods (e.g. Beven et al. 2008); an appraisal of the situation for forest landscape models is missing.

Here, we aim to illustrate the problem of model structural deficiencies for calibrating forest landscape models and to discuss approaches for dealing with it.

Literature cited: Beven KJ, Smith PJ, Freer JE (2008) So just why would a modeller choose to be incoherent? Journal of Hydrology 354:15â€“32. doi: 10.1016/j.jhydrol.2008.02.007; Hartig F, Calabrese JM, Reineking B, et al (2011) Statistical inference for stochastic simulation models â€“ theory and application. Ecology Letters 14:816â€“827. doi: 10.1111/j.1461-0248.2011.01640.x

Snag "Survival": Longevity of Standing Dead Ponderosa Pines after Crown Fire Versus Bark Beetle Outbreak in Southwest

Joy Nystrom Mast, Carthage College, and Carol Chambers, Northern Arizona University*

Across the United States and Canada, prolonged droughts, high forest densities, and predicted increases in thermal regimes indicate a high potential for unprecedented large crown fires and epidemics of bark beetles and associated tree mortality. Snags are natural as dynamic components of forests, changing in quality and quantity over space and time. In northern Arizona, ponderosa pine snags can remain standing 120 years. Today, southwestern ponderosa pine forests are altered from their historic range of variability by dramatic increases (i.e., 60-fold) in survival of smaller trees, canopy cover, and coarse woody debris. In our long-term study of snags, we have established a network of 1-ha plots in crown fire sites, bark beetle killed sites, and control sites to follow the "life cycles" of snags. Snags were significantly clumped with patches up to 25-m radii based on mapping snags and Ripley's K(t) statistic. Snags exhibited positive spatial autocorrelation for size at smaller distances based on Moran's I, indicating patches with similarly sized snags. In contrast, snags showed negative spatial autocorrelation at medium and larger distances, representing patches of mixed-sized trees. Survival analysis for crown-fire burned snags running PROC LIFETEST provided a survival estimate of 7.87 years. When compared to bark beetle killed trees, although 99% of beetle-killed snags were standing 3 years after outbreaks only 20% remained standing after 7 years and <10% standing by year 9. Snags that remained standing had lower surrounding basal area, larger dbh, and more limbs, were more decayed, and were on west-facing lower slopes.

Spontaneous reforestation of mountainous landscapes: global lessons from Europe

Tommaso Sitzia, University of Padova

Spontaneous reforestation of vast former pastoral and agricultural lands may occur in mountainous regions due to socio-economic, political, and climatic factors. As a consequence, several animal and plant species will undergo changes in their habitat quality, behaviour and demography, which finally may reduce connectivity. Historical sources attest that such trends have cyclically occurred in Europe. Once again, Europe is largely affected by the abandonment and spontaneous reforestation of mountainous old-fields. Similar trends in other continents might be underestimated due to long-term effects, time lags in ecological responses, and absence of economic interest towards the land uses which are being lost. Moreover, landscapes where these changes take place are a mixture of open and closed tree and shrub canopies, hence the shrinking of fragmented habitats is rather difficult to be appreciated, unless long-term monitoring is available. In addition to those being threatened, some of the affected species may be of interest for humans, hence a reduction of services' provision is possible. As a

conclusion, it is important to raise awareness of the issue and to develop a forum of scientists and practitioners also from regions outside Europe.

Landscapes of Environmental Justice: An Analysis of Ecological Structures

Sima Namin, Ph.D. Candidate at the University of Texas at Arlington

The American school of environmental justice (EJ) is focused on fixed locations, which is the result of the dominance of distributive justice in this field (e.g. Schlosberg, 2004). But, recent human health paradigms argue that health cannot be characterized by a single environmental hazard or pollution point; instead, health status should be described as a result of complex interrelations between socioeconomic and environmental factors (e.g. Tarocco, Amoruso, Caravello, 2011). Accordingly, studying EJ, requires an understanding of environmental health too, as many researchers have found a relationship between human health and environmental/ecosystem health (e.g. Epstein & Rapport, 2002). To study the states of EJ, in this paper, I try to find indicators to analyze environmental health and vulnerability in Dallas metropolitan area. Two main layers of vulnerability are the extent of (potential) exposure to environmental health hazards and coping capacity (Hynes & Lopez, 2007). The methodology designed aims to provide both environmental health indicators and human factors through a geo-spatial analysis inspired by landscape ecology principles/metrics. Such principles help with the analysis of environmental/ecosystem health through examining landscape patterns. These landscape indicators can be used to compare different landscapes at different time periods, identifying the change processes. The result will be used later in the analysis to compare the environmental/ecosystem health in different urban landscapes. A series of environmental quality indices will be assigned to each landscape. The Average Ecological Quality (AEQ) score assigned to each landscape will ultimately be used to study the patterns of health risk disparities.

A New Map of Important Bird Areas in Alaska

Melanie Smith, Audubon Alaska; Nathan Walker, Iain Stenhouse, Christopher Free, Matthew Kirchhoff, Olga Romanenko, formerly Audubon Alaska; Stan Senner, National Audubon Society; Nils Warnock, Audubon Alaska; and Vivian Mendenhall, (retired US Fish & Wild

During a multi-year process of identifying Important Bird Areas (IBAs) in Alaska we established new methods for identifying globally significant bird hotspots using four major data types: pelagic boat-based transects, marine bird colony surveys, coastline aerial censuses, and aerial transects in interior Alaska. We combined the results together to update our previous set of expert-derived IBA boundaries. In total, there are 207 IBAs across Alaska's land and sea covering over 370,000 km2 (>90 million acres). Of those, 48 are long-recognized IBAs not reproduced due to data gaps in the new spatial analysis; 79 are long-recognized IBAs that were revised with modified boundaries and trigger species; and 80 are newly established. Alaska has 182 IBAs that meet the criteria for global significance established by BirdLife International and the National Audubon Society, more than any other US state. While the IBA criteria favor congregatory bird species (seabirds and waterbirds), IBAs are identified for 85 different species, including geese, ducks, loons, grebes, albatrosses, shearwaters, storm-petrels, cormorants, raptors, shorebirds, gulls, terns, alcids, and songbirds. This new map of IBAs in Alaska will be broadly useful for conservation planning, policy and management recommendations, and education around the state.

Assessing changes in urban form across city and peri-urban scales in Africa

Shuaib Lwasa, Associate Professor, Makerere University

This paper discusses the utilization of geospatial analysis of urban landscapes dynamics and changes. Africa is reported to be a continent in transition, the most urbanizing region with diverse drivers specific to particular urban systems. With the projected urbanization and economic development, natural landscapes are likely to change in a way and scale that has not happened in the history of Africa's urbanization. This paper argues that a better understanding of the drivers and dynamics of urbanization across scales will inform policy-informed decisions in managing natural resources. The paper analyses the utilization of imagery in urban growth analysis in and around several cities from different ecosystems of coastal, inland mountainous and Sahel-desert cities. The spatial growth of cities in Africa illustrates how regional scale environmental policy is evolving but also illuminates the need for consideration of multiple scale dynamics of landscapes for a better enhancement of ecological services. With climate change a reality and disasters increasing on the continent yet the promising economic growth is an imperative, managing ecosystems for sustainability is as important as ever also reflected in the draft Sustainable Development Goals. Geospatial technologies have played a role in stocking ecosystems and urban built up but have not been applied in analyzing thresholds and tipping points for sustenance of ecosystems at various scales.

The effects of landscape intensification on the thermal biology of aphid pests

Lucy Alford, UMR-CNRS 6553 ECOBIO, University of Rennes 1 ; Joan van Baaren, UMR-CNRS 6553 ECOBIO, University of Rennes 1 ; Francoise Burel, UMR-CNRS 6553 ECOBIO, University of Rennes 1*

The earth is presently experiencing changes in both climatic conditions and landscape structure. Over the past century the climate has warmed by approximately 0.6Â°C and the incidence of extreme climatic events such as droughts and heat and cold waves has increased. In addition to climatic changes, much of Europe has experienced large scale intensification over the past 50 years. This intensification has led to an increase in agricultural productivity but also to a simplification of agricultural landscapes, a loss of biodiversity and a degradation of ecosystem services. The current study aimed to investigate the effects of landscape intensification on the thermal biology of an insect to better understand how landscape and climate change may interact to affect the abundance of pest species. Three primary aphid pests of cereal fields (Sitobion avenae, Metopolophium dirhodum and Rhopalosiphum padi) were sampled in cereal fields of North-West France in winter and spring 2013/14 from contrasting landscapes: coarse grain landscapes and fine grain heterogeneous 'bocage' landscapes. Indices of thermotolerance (CTmin) were measured to determine if thermal tolerance varies between habitat types and seasons in the same landscape category. Results revealed that, for the winter population of aphids, those originating from fine grain landscapes were more cold tolerant than those originating from intensive coarse grain landscapes (as indicated by lower temperatures of CTmin).This pattern was not observed for spring populations. These results are discussed in light of previous findings concerning the natural biological control agents of cereal aphid pests: the carabid beetles and the parasitoid wasps.

Mapping the cumulative impacts of mining on ecosystem services

Zhenyu Wang, Centre for Mined Land Rehabilitation, Sustainable Mineral Institute, The University of Queensland, Australia; Alex Lechner, Centre for Social Responsibility in Mining,Sustainable Mineral Institute, The University of Queensland, Australia; Th*

Abstract: Mining development potentially leads to cumulative impacts on ecosystems and their services from minimal, site-specific pollution to large-scale ecosystem degradation. Although various methods for ecosystem services assessment have emerged in recent years, there are no examples in the literature of where mining impacts on ecosystem services have been assessed. This study presents a methodology to map and quantify the cumulative impacts of mining on multiple ecosystem services

based on the Integrated Valuation of Ecosystem Services and Trade-offs (InVEST) model. Using this model, provisioning services (water, food and timber), regulating services (carbon sequestration, water purification and sediment retention) and supporting service (habitat quality) were assessed in the Fitzroy Basin of Australia, a resources intensive region with multiple mining activities. Values and spatial distribution of these ecosystem services were calculated and mapped under different scenarios, which were modelled through increasing mining footprint (mine development) or reducing mining footprint (mine close or rehabilitation).Trade-offs, synergies and losses between each ecosystem service were analysed. We found that the trade-offs and synergies among these ecosystem services were strongly dependent on land use patterns, environmental conditions and mine regional planning. The method described in this paper provides decision-makers and planners with a tool for sustainable regional and landscape planning that balances the needs of mining with the provision of ecosystem services.

Remotely-sensed phenology of regional vegetation condition in response to extreme droughts and its implication to the regional planning

Youngkeun Song, Brain Korea 21 Plus Team, Seoul National University, Republic of Korea

The quality of regional ecosystem services is closely related with the condition of vegetation in the area. In future conditions with more intensified heavy precipitation and drought events, it is critical to understand the variations in vegetation condition in relation to extreme precipitation, because of the implications for regional landscape management. Previous analyses were not based on the geographical features, but limited to the administrative-district boundary, although the distribution of degraded landscape would describe site-specific mosaics. Also the previous hazard-map studies largely focused on the variation in water resources, rather than the response of vegetation community under the extreme climate condition. This study attempts to assess the vulnerability of vegetation condition in extreme drought years. The methodology for the vulnerability assessment will be based on the phenological changes observed by multi-temporal satellite dataset over the last decade. Time-series profiles of vegetation condition in the extreme drought and normal precipitation years were acquired by using the values of Enhanced Vegetation Index (EVI), which was provided in the Terra MODIS remote sensing dataset (MOD13Q1) taken every 16 days at the scale of 250-m spatial resolution. These per pixel phonological features could be used to estimate drought impact, and its vulnerability and resilience to the severe drought. This outcome is expected to identify spatial characteristics related with the extreme drought event. The description could be helpful to determine a priority in the measures for an unexpected weather condition of future, and to manage local landscape.

Exploring complex interactions among multiple disturbance agents in forest landscapes: simulating effects of fire, beetles, and disease under climate change

Robert E. Keane, USFS Missoula Fire Sciences Laboratory; Rachel Loehman, USGS Anchorage, Alaska; Jason Clark, USFS Missoula Fire Sciences Laboratory; Erica A H Smithwick, Penn State Univ, State College, PA; Carol Miller, Aldo Leopold Research Institute, R

Complex reciprocal interactions among disturbance, climate, and vegetation dramatically alter spatial landscape patterns and influence ecosystem dynamics. Dynamic interactions between multiple disturbances can also change landscape trajectories, especially in new climate regimes. Frequencies and severities of native and exotic disturbances are likely to change with changes in climate, and their interactions could result in novel landscape structures and composition. Ecological models are used routinely to explore ecological dynamics across heterogeneous landscapes, but few models are able to simulate effects of multiple interacting disturbance events. Projecting how multiple disturbances interactions might result in novel emergent landscape behaviors is critical for addressing climate change

impacts and designing land management strategies. In this paper, we will review the literature on multiple disturbance interactions for field and modeling studies and use the landscape process model FireBGCv2 to simulate effects of multiple disturbance interactions (mountain pine beetle, white pine blister rust, wildland fire) on vegetation composition and basal area under historical and future climates for landscapes of the northern Rocky Mountains. Results show that, under current and future climates, (1) landscape behavior is significantly different when multiple disturbances interact as compared to no disturbances or only a single disturbance type; (2) most inter-disturbance interactions are indirect feedbacks mediated through changes in vegetation and fuels; and (3) disturbance interactions may overwhelm any direct effects of climate or effects of a single disturbance.

Oppla: building an ecosystem services resource hub for science, policy and practice

Marta Perez-Soba, Alterra - Wageningen University and Research Centre; Claire Brown, UNEP-WCMC; Mark Rounsevell, The University of Edinburgh; Marc Metzger, The University of Edinburgh; Peter Verweij, Alterra - Wageningen University and Research Centre; Be

The ecosystem services concept is seen by many as a useful paradigm to support decision-making at the complex interface between science, policy and practice. However, to be successful, it requires a strong willingness for collaboration and joint understanding. In support of this aspiration, Oppla is being developed as a web portal to enable European communities to better manage ecosystems for human well-being and livelihoods. Oppla will provide access to a variety of online resources such as tools, case studies, lessons learned, videos, manuals and training and educational materials. It will also provide expert forums and spaces for discussions between researchers, practitioners and decision makers. Hence a critical aspect of the success of Oppla is the co-evolution of communities of practice that link best practice experience with knowledge on ecosystem services and natural capital. This presentation will discuss the development of Oppla and the communities of practice that are emerging around it, as an introduction to the further symposium.

Balancing Conservation with Public Safety: Landscape Planning for Fire-Dependent Communities

Brian R. Miranda, Brian R. Sturtevant, Susan I. Stewart - USDA Forest Service Northern Research Station; Roger B. Hammer, Oregon State University; Eric J. Gustafson, USDA Forest Service, Northern Research Station; David J. Mladenoff, University of Wiscon*

Fire-dependent communities are declining worldwide in the face of fire suppression, natural resource management, and land development. In the context of a changing climate and mixed-ownership landscape with continued development, can fire-dependent communities be restored/maintained without increasing risk to human safety? The objective of our study was to examine the long-term trade-offs between restoration of fire-dependent ecosystems and fire risk to human property in a mixed-ownership landscape, the Northeast Sands ecoregion of Wisconsin, where the conflict between restoration and human development is acute. We evaluated the long-term consequences and relative influence of 1) land development patterns, 2) alternative forest management strategies, 3) social constraints on harvest activity and 4) changing climate, on human safety and ecological restoration goals. Landscape simulations using the LANDIS-II model incorporated previously documented relationships between fire ignitions and both human development patterns and climate (i.e., drought). We evaluated the influence of the four factors on fire-dependent communities by measuring the projected area and fragmentation of fire-dependent forest types, and the habitat suitability for four bird species of concern in Wisconsin. We also projected impacts on human fire risk by quantifying the annual area burned in developed and non-developed areas.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

What Machine Learning, Ensembles and Open Access have brought us: Seeing the Data Signals in the Trees of changing Landscapes worldwide for the 21st century

Falk Huettmann, EWHALE lab- Inst. of Arctic Biology, Biology & Wildlife Department, University of Alaska Fairbanks, Fairbanks, Alaska, USA

Machine Learning offers us a set of over 20 complex non-parametric algorithms to tackle virtually all spatial and temporal subjects in Landscape Ecology. Based on published and peer-reviewed 20 applications worldwide here I provide an overview what Machine Learning is, how ensemble models are defined, and how inference is made through best-possible predictions according to Leo Breiman. These reviewed projects are all based on underlying shared public Open Access data and allow to infer on the shortcomings in earlier approaches, including parsimony, linear models and single hypothesis testing. I conclude with the obtained gain for management and conservation in machine learning algorithms, and highlight the need for more development, promotion, standardization and metadata in machine learning and its underlying data. While this review features published land- and seascape research and data worldwide, I conclude with a call for more of such applications covering the diversity of spatial and temporal management projects during climate change and with relevance for a global management and sustainability!

Response of Riparian Vegetation in Australia's largest River Basin to Inter and Intra-Annual Flooding: A Data-Driven Quantification Using Landsat and MODIS Remote Sensing Data

*M. Broich, *, M.G. Tulbure, R. Kingsford, R. Lucas, D. Keith -School of Biological, Earth and Environmental Science, University of New South Wales, Sydney, Australia*

Australia is a continent subject to high rainfall variability, which has major influences on vegetation greening. However, the resulting spatial-temporal pattern of flooding and its influence on riparian vegetation has not been quantified. Here we focused on the floodplains of the entire Murray-Darling Basin of Australia as a case study. The MDB is the country's primary agricultural area with scarce water resources impacted by climate change and extensive zones with degrading riparian vegetation.
We advance our understanding of the relationship between climate-driven flooding dynamics and vegetation response at the sub- continental to local scales and across inter to intra-annual time scales based on almost three decades of Landsat and one decade of MODIS imagery. We chose to model riparian vegetation response to flooding using remote sensing data-driven space-time statistical approaches.
We use Landsat TM and ETM+ data to synoptically map spatially detailed dynamics of flooding with an internally consistent machine learning algorithm. We derived riparian phenology from MODIS data and attributed differences in vegetation response to flooding dynamics, vegetation types and sub-basin land use.
Vegetation community response to flooding varied in space and time and with vegetation types, densities and location relative to areas frequently flooded. Phenological degradation trends were observed over riparian forests and woodlands in the center and southern parts of the basin that are primarily farmed. These are also areas where flooding regimes have changed the most to less frequent and smaller inundation extents. Conversely, herbaceous vegetation phenology followed primarily a boom and bust cycle related to less extensive flooding dynamics. This pattern was found across different areas of the basin. As expected, flooding regimes and vegetation response patterns were fine grained, confirming the choice of a spatially explicit, internally consistent analysis leading the path for ongoing analysis.

Remote sensing time series provide rich and spatially explicit observation x- and y-variables for top down statistical modeling of the response of riparian vegetation to flooding that will be presented here. Ongoing work will statistically model the role of climate variables (e.g. local rainfall, temperature, evapotranspiration) on riparian vegetation. Results are of interest for land and water management decisions and the design developed here can be applied to other areas globally such as the Nile river basin and Okavango River delta in Africa or the Mekong River Basin in Southeast Asia.

International Food Trade among Biodiversity Hotspot and Non-hotspot Countries

Min Gon Chung, Center for Systems Integration and Sustainability; Jianguo Liu, Center for Systems Integration and Sustainability, Michigan State University, East Lansing, MI, USA*

International food trade is an important telecoupling process that facilitates food security (e.g., production, supply and demand) across the world. Since food production is a basis for food trade but threatens biodiversity in many ways (e.g., conversion of wildlife habitat to cropland), understanding food trade among countries with and without biodiversity hotspots is essential for uncovering the causes of biodiversity loss and for identifying responsible parties. Using a comprehensive dataset from 1992 to 2011, we found that biodiversity hotspot countries were net food exporters. They provided twice more food to non-hotspot countries than what the latter provided to the former. The food export from hotspot countries accounted for 8.4% of total food production in non-hotspot countries. The main drivers of food trade included total food production, per capita food production, and income level. The percentage of protected areas and biodiversity hotspots were positively associated with food export, while the percentage of agricultural area and urban population influenced food import. Also, food productivity and agricultural intensification in hotspot countries have exceeded those of non-hotspot countries after the early 2000s. The results suggest that non-hotspot countries share the responsibility of biodiversity loss and emissions of greenhouse gases from agriculture in biodiversity hotspot countries.

Landscape, environmental and social predictors of Hantavirus risk in the State of SÃ£o Paulo, Brazil

Paula Ribeiro Prist, University of SÃ£o Paulo; Maria Uriarte,Columbia University; Jean Paul Metzger, University of SÃ£o Paulo*

Hantavirus Pulmonary Syndrome (HPS) is a disease, highly virulent to humans, transmitted by habitat generalist rodents, that increase in abundance through human-driven landscape changes. Climate can also affect rodent population dynamics and HPS virus survival, while social aspects influence HPS transmission to humans. Here we relied on a Hierarchical Bayesian model to quantify the associations between HPS incidence and climate, landscape, and social factors across the 645 municipalities of SÃ£o Paulo state, Brazil, where 207 HPS cases were reported between 1993 and 2012. Landscape factors (proportion of native habitat cover, number of fragments and proportion of sugarcane), climatic factors (precipitation and temperature), and social variables, namely the number of men older than 14 years (i.e., the risk population) and Development Index (IDH) were included as predictor variables. We built separate models for the Cerrado and Atlantic forest biomes. In savannas, hantavirus transmission risk increases with high sugarcane land cover, large number of patches, hot temperatures, and high IDH. In contrast risk of hantavirus incidence in the Atlantic Forest region, is higher as the number of patches and the amount of forest cover increases. There is also a positive relationship with annual mean temperature, IDH, amount of sugarcane in the landscape and population. Our analysis provides evidence that social, landscape and climate factors are strongly associated with HPS incidence, providing a framework to infer HPS risk and to develop management action that minimize the risk of hantavirus outbreaks.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Spatial patterns of forest fragmentation as indicators social-ecological change in human-dominated tropical landscapes

Kathryn R. Kirby, University of Toronto Alexandre Camargo Martensen, University of Toronto Colin Daniel, University of Toronto Marie-Josee Fortin, University of Toronto*

Changes in the amount and spatial arrangement of forest cover in a region can have important implications for biodiversity and the delivery of ecosystem services. As the product of social processes, changes in landscape pattern also have the potential to serve as indicators of social change. For example, increasing aggregation of agricultural clearings in tropical landscapes may be indicative of land concentration, and/or of a shift from locally-oriented to export-oriented agricultural production. Despite this potential, the application of landscape pattern metrics to understanding social change lags behind their application in fields such as conservation ecology. We quantified landscape pattern for a global sample of tropical and subtropical forest landscapes at two points in time. The analysis used recently-released 30m-resolution forest cover data for the globe for the years 2000 and 2012. Pixels were classified as forest or non-forest, with urban and aquatic areas masked out. In each biome, landscapes were grouped according to the general type of pattern transition they had undergone over the 12-year study period, distinguishing between changes in proportion of forest cover and changes in the configuration of cleared vs. forested areas. We then related the pattern transitions to spatially explicit data on factors such as human population density, transport infrastructure, topography, and forest governance. We will present preliminary results of this research, highlighting the potential for landscape pattern analysis to reveal hotspots of social-ecological change and to assist policy-makers in relating these changes to socio-economic and biophysical drivers at different spatial scales.

Exploiting model underperformance to understand the impacts of policy intervention on land cover change

Andrew V Bradley, Imperial College London; Isabel MD Rosa, Imperial College London; Robert M Ewers, Imperial College London.

Some landscapes are subjected to an abrupt or non-linear variation in land cover change processes and calibrated models often have difficulty accounting for a process variation. Under these circumstances allocation and quantity of change in the model projection is unlikely to replicate the reference data set. This problem can have a purpose because the difference between the actual and projected change can be exploited to identify what happens when sudden variations in land cover change processes are instigated. However, with no data to validate against the accuracy of the model projection is unknown along with the uncertainty that the model carries. To improve on the accuracy and uncertainty of a single model projection a multi model approach is explored to identify consistent land change outcomes and uncertainty in a tropical deforestation scenario. Several models are calibrated to run a business as usual projection and to quantify the overall differences between the multi model projections and reality, quantitative, spatial and allocation metrics are used. This kind of retrospective analysis can help understand how a sudden change in land cover processes such as policies on forestry, agriculture, and credit subsidies change or preserve the environment.

New perspectives for landscape ecology expansion

Jean Paul Metzger (University of Sao Paulo, Brazil)

Landscape ecology has developed rapidly in the two last decades under the influence of two main general approaches, the North American and the European, with scientific publications concentrated in

few countries (e.g. USA, Canada, UK, Australia). The characteristics of those approaches can be explained by the sociological, cultural and environmental context in which they developed. However, nowadays landscape ecology is growing very fast in other regions, within distinct environmental and historical conditions, such as in tropical countries from Latin America and south Asia. These new emergent regions offer new challenges, related with the conservation of highly biodiverse ecosystems, such as the Amazonian forests, in dynamic landscapes, which are being rapidly modified by human activities, particularly by the expansion of monocultures and highly populated urban areas. The high rates of habitat loss and fragmentation, in association with a fragile legal protection of natural habitats in most tropical countries, make urgent a stronger link between science and management practices, where researchers and practitioners of landscape ecology can play an important role. Landscape ecology in tropical regions is still concentrated in few countries and research/educational institutions. To support its expansion, a consistent educational program should be developed, preferentially with the support of the leading countries in the emergent regions. The expansion of landscape ecological research outside the US-Europe-Australia temperate and dominant regions can help to explore new research axes, possibly enriching the existing landscape ecology approaches.

Altered fire regimes in temperate rainforests in Patagonia and Tasmania.

Andres Holz, Portland State University; Sam W. Wood, University of Tasmania, Australia; Juan Paritsis, Ecotono INIBIOMA Lab, Universidad del Comahue, Argentina; Thomas T. Veblen, University of Colorado; and David M.J.S. Bowman, University of Tasmania, Au*

Rapid changes in landuse and climate have altered the disturbance regime and ecological resilience of temperate rainforests, including those in the southern hemisphere. Dendroecological research in Patagonia show that fire regimes were initially altered by Euro-settlers, as they increased the frequency of ignitions compared to those caused by lightning and Indigenous burning, and they co-occurred with favorable fire-weather associated with large-scale climate oscillations. Results from Tasmania, indicate that Euro-settlers maintained the Aboriginal fire regime, but some of their burning coincided with historically unprecedented droughts that resulted in massive fires. In both ecosystems the common postfire vegetation transition can be summarized by as a regional-scale tree regeneration failure involving the overall retreat of formerly dominant and fire tolerant tree species, and replacement by abundant shrubs. The loss of tree cover is likely permanent given the relatively high fuel loads of postï¬re vegetation communities that are dominated by resprouting shrubs. We suggest that the feedback between regeneration failure and increased ï¬,ammability will be further exacerbated by a warmer and drier climate and by the increased ignition rates due to more frequent convective storms and increased human presence associated with growing ecotourism in remote areas.

Anthropogenic effects in landscapes: concepts and analysis

Jan Bogaert, University of Liege - Gembloux Agro-Bio Tech; Marie Andre, University of Liege - Gembloux Agro-Bio Tech; Isabelle Vranken, University of Liege - Gembloux Agro-Bio Tech*

Landscapes undergo changes as a result of human actions. Application of the pattern-process paradigm enables the study of anthropogenic effects through pattern analysis. Landscape pattern can be analyzed by considering its two components: composition and configuration. A series of concepts and examples regarding pattern analysis is discussed to illustrate anthropogenic effects in landscapes. Most examples are taken from studies in Africa.

Bundling food with other ecosystem services: A historical perspective on multifunctionality in southern Quebec

Delphine Renard, Department of Natural Resource Sciences McGill; Elena M Bennett, Department of Natural Resource Sciences and McGill School of Environment McGill; Jeanine M Rhemtulla, Department of Forest and Conservation Sciences, University of British C

How can we manage landscapes to provide multiple-often conflicting-ecosystem services (ES)? Answering this question requires that we move beyond the assessment of ES at a single point in time. A historical perspective to ES can provide insight into how ES bundles emerge, how synergies and trade-offs change through time, and the drivers of these changes. To test this approach, we reconstruct nine ES over the past 35 years in an agroforested landscape of southern Quebec, Canada. Our results show that, although almost all individual services increased in abundance over time, multifunctional bundles providing high levels of all ES did not emerge. Instead, bundles diversified and specialized in the provisioning of a few, abundant services in response to changes in agricultural policy. Across space, social-ecological characteristics of the region led to the formation of a marked landscape-scale trade-off between provisioning, regulating and cultural services through time. Our results suggest that, although multifunctional bundles are hypothetically possible and an ideal target to enhance and guarantee ecosystem stability and the well-being of people, they may be unlikely to emerge in productive landscapes without very specific management practices.

The 70 years greenery history of Hiroshima an A-bombed city

Nobukazu Nakagoshi, Graduate School for IDEC, Hiroshima Univesity, Japan*

As of 2014, Hiroshima City has an estimated population of 1.185 million and an area of 905.41 km2, and it has been regarded as a metropolis in Japan. On August 6, 1945, Hiroshima became the first city in the world to have an atomic bomb dropped on it, and the delta area was completely destroyed. Almost all the vegetation was burnt and disappeared from the area. The content and achievements of greenery campaign have been summarized by linking the greenery history. The achievements of the first to third greenery campaigns have been analyzed individually from the viewpoint of the social environmental management system (SEMS). The first campaign corresponds to the system-making stage of the SEMS, the second is the system-working stage, and the last was categorized as the self-management stage. Compared with the abiotic environmental problem, the time needed to achieve the goals of each greenery campaign was much longer, because of a variety of struggles caused by urban development in the limited space of the delta area. A case study was conducted on the small parks in the deltaic urban zone in the 2nd greenery master plan (2011-2020). Unexpectedly, new parks have fewer plants and simple structural diversity. In 2014, the townscape ordinance was newly adopted. Problems relating to the greenery policy and the future direction of biodiversity conservation in urban areas are also discussed in the post-third greenery campaign. Along this ordinance, I would like to discuss the 70 years greenery history of Hiroshima City.

Introduction to Symposium

Jiali Wang, University Chinese Academy of Sciences; Jian Yang, Insistute of Applied Ecology, Chinese Academy of Sciences; Fuqiang Zhao, Insistute of Applied Ecology, Chinese Academy of Sciences; Shengwei Jiang, Mountain Protection Bureau of Liaonin*

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Effect of Wildlife Gardens on Butterflies at Landscape and Garden Scales

Jessica Kurylo, Faculty of Science, University of Melbourne; Caragh Threlfall, Faculty of Science, University of Melbourne; Karl Evans, Department of Animal and Plant Sciences, University of Sheffield; Nicholas S. Williams, Faculty of Science, University*

Wildlife gardening has become a popular idea to promote biodiversity in urban areas via engaging local communities, but there are few empirical assessments of their effectiveness to sustain or improve biodiversity within the urban matrix. This study focused on a biodiversity gardening program sponsored by the City of Boroondara, a suburb of Melbourne, Australia, to test the hypothesis that wildlife gardens have a measurable positive impact on butterfly species richness and abundance both at the landscape scale and locally, at the garden scale. Thirty randomly selected landscapes (each 0.5x0.5km), were surveyed for butterflies and floral abundance, where 15 landscapes had wildlife gardens present and 15 did not. Within these landscapes, 81 gardens (27 of each type: wildlife gardens, traditional gardens nearby to wildlife gardens, and traditional gardens not nearby) were also surveyed for butterflies and floral abundance. From the surveys, a total of seven species were identified in the landscapes and only one additional species identified during garden surveys. Preliminary results indicate no significant difference in either butterfly species richness ($p>0.05$) or abundance ($p>0.05$) between landscapes with or without wildlife gardens or between garden types ($p>0.05$). Our results also indicate little effect of floral abundance, as floral abundance did not differ between garden types ($p>0.05$), however floral composition or quality may be important. Counter to our hypothesis, we found that wildlife gardens do not promote or sustain more diverse and abundant butterfly populations compared to traditional gardens within the urban matrix.

Combining field and greenhouse experiments to understand the relationship between climate and budburst in coast Douglas-fir

Kevin R. Ford, USDA Forest Service Pacific Northwest Research Station; Constance A. Harrington, USDA Forest Service Pacific Northwest Research Station*

The timing of annual growth initiation in plants has large impacts on species distributions and ecosystem function, and is sensitive to climate. Warmer spring temperatures have generally led to earlier budburst (initiation of primary growth) in temperate plants. However, many species require exposure to cool temperatures (chilling) as well as warm temperatures (forcing) during the winter and spring to burst bud. Warmer winters could disrupt this process. Specifically, trees experiencing reduced chilling may require more forcing to burst bud, which could delay or even prevent budburst. We studied the timing of budburst in coast Douglas-fir (Pseudotsuga menziesii var. menziesii) by combining data from a field study spanning much of the tree's range (where plants experienced medium to large amounts of chilling) and a greenhouse study (where we manipulated the amount of chilling plants experienced from low to medium). In the field study, we found little difference in the forcing required for budburst across the range of chilling values, with required forcing being slightly higher at the lowest chilling values. But in the greenhouse study, as chilling values declined past those experienced in the tree's native range, the forcing required for budburst increased rapidly. Moreover, low chilling resulted in increasingly high proportions of trees failing to burst bud. As climate change leads to reduced chilling, coast Douglas-fir near the tree's southern range limit may approach a threshold at which the forcing required for budburst increases substantially and the budburst process is altered, leading to potential growth reductions and range contractions.

Influence of map accuracy on modelling species diversity of hoverflies

P.-A Herrault1,3, L. Larrieu2 ; A. Ouin1, D. Sheeren1 1University of Toulouse, INP-ENSAT, UMR 1201 DYNAFOR, France 2INRA, UMR 1201 DYNAFOR, France 3University of Toulouse, Toulouse Jean JaurÃ¨s, UMR 5602 GEODE, France*

Although it is widely recognized that spatial uncertainty can affect the ecological analyses, most of the studies use spatial data without given attention to this issue. Here, we assess the effect of misclassification errors and geometrical inaccuracies of forest habitats to explain species richness of hoverflies (Diptera: Syrphidae). Species richness was sampled in 49 woodlots located in southwest France. Area and connectivity of woodlots were used as predictor variables to describe landscape factors, in addition to history and local structural heterogeneity variables. The estimation of area and connectivity was made from two spatial datasets based on the same aerial photographs: a forest map digitized by hand and another map produced automatically following a geographic object-based image analysis. Generalized Linear Models were fitted to explain and predict species richness of forest hoverflies. Contrary to expectations, results show negligible impact of geometrical inaccuracies on models performance (delta-DÂ²=4%, delta-AIC=0.27 and delta-RMSE=0.20 between the models based on data extracted manually or automatically). High correlations were observed between area and connectivity of the two datasets (r=0.94 and r=0.85 respectively). However, misclassification errors (kappa = 0.72) and especially omission errors (30.64%) strongly influence the robustness and validity of the model because of a drastic reduction of sample size (from 49 to 27 woodlots). We conclude that the classification accuracy is more important than the geometrical accuracy when modelling species diversity of forest hoverflies.

Urban sprawl: Methods, drivers, limits and implications for planning

Felix Kienast, Swiss Federal Research Institute WSL

Symposium leader

Distinctive Nature of Frequent Fire Forest Ecosystems and Landscapes

Jerry F. Franklin School of Environmental and Forest Science, University of Washington, Seattle WA

Frequent-fire coniferous forests are forest and savanna ecosystems developed and sustained under regimes of frequent (<30 year interval), low- to moderate-intensity fire. These forests commonly have discontinuous overstory canopies of low to moderate density; sparse mid-story canopies; and herbaceous or shrubby understories, which are often compositionally diverse. Structural and habitat heterogeneity commonly is present as a fine-scale (e.g., 0.05 to 1 ha) mosaic of structural patches. Tree dominants are commonly one or more species of pine or larch and often include one or more species of oak or other hardwood. Such forest ecosystems display high resistance and resilience to fire. Some other characteristic attributes where fire regimes are sustained (i.e., not suppressed) include: 1) high levels of continuity due to the rarity of stand-replacement events in frequent-fire landscapes; 2) complex relationships between productivity and fire frequency, such as the necessity for highly productive frequent-fire forests to have high fire frequencies; and 3) high potential for adaptation to climate change. Some frequent-fire forests, such as those occupied by pitch pine, contrast with the characteristic pattern described previously.

Implementation of measures against urban sprawl: learning from best practices in Switzerland

Anna M. Hersperger, Swiss Federal Research Institute WSL; Gierina Cathomas, Swiss Federal Research Institute WSL*

Urban regions are undergoing a highly dynamic process of growth and sprawl, with dramatic consequences for the provision of ecosystem goods and services. Planning has a long tradition to guide urban development patterns in a sustainable way. Since several decades Swiss municipalities implement measures to limit the expansion of the settlement area and to achieve dense settlements. We studied 15 municipalities of various sizes that experienced a positive development regarding the WUP- sprawl metric to identify best practices, i.e. spatial planning measures and implementation procedures that contributed to this positive trend. We chose a case study approach based on expert interviews and document analysis and focused on the past four decades. Because of the federalist government structure and the high municipal autonomy in planning issues we found a wide array of measures, often precisely adapted to the municipal needs and scope. Overall four measures have been especially effective in the studied municipalities: the reclassification of building zones into non-building zones, refined utilization coefficients, special district plans, and urban growth boundaries. These examples illustrate how despite population growth and economic development municipalities were able to successfully limit sprawl.

Scaling issues in predicting the spread of aquatic nuisance species.

Jonathan Bossenbroek, University of Toledo*

Predicting the spread of aquatic nuisance species can aid in early detection and preventative control at early stages of an invasion. The spread of these species, however, is a function of processes that act across a wide range of scales. Individual species have different capabilities to spread locally through their own efforts or via natural forces such as stream flow or currents. These species can also be transported locally, regionally, and globally via anthropogenic vectors such as shipping and the live-animal trade. I will use examples from the Laurentian Great Lakes and Caribbean to demonstrate models of spread that cross scales and have been used to aid in regional management. In the Great Lakes a multi-model approach was used to determine the potential effectiveness of a suggested ballast water management technique, ballast water exchange, in preventing the further spread of Eurasian ruffe (Gymnocephalus cernuus). The natural spread was simulated using a 3D hydrodynamic model and then combined with a ballast water spread model to determine where ruffe may next be spread in the Great Lakes. In the Caribbean, oceanic currents and shipping models were used to predict the spread the Asian green mussel (Perna viridis), which arrived in Trinidad and Tobago in 1990. Since this introduction, secondary spread of P. viridis has resulted in populations in Venezuela, Cuba, Jamaica and Florida. Predicting future spread of these species can aid in monitoring, early detection, and an assessment of potential damages.

A socio-ecological framework for the analysis of forest edges dynamics and their consequences on ecosystems services in temperate landscapes.

*Marc Deconchat *, INRA, Dynafor; Audrey Alignier, INRA, SAD-Paysage; Annie Ouin, INPT, Dynafor; Emilie Andrieu, INRA, Dynafor; Antoine Brin, INPT, Dynafor; Luc Barbaro, INRA, Biogeco; Herve Jactel, INRA, Biogeco*

Edges between forest and farmland are frequent in many temperate landscapes. They are known to play key roles for ecological but also social interactions and therefore deserve a special attention from landscape ecologists for a better understanding and management. We present a general framework, based on the socio-ecological system theory, for organizing the wide range of point of views on edge dynamics and their consequences for agro-ecosystem functioning. Forest edges are the result of a local sparing of agriculture and forest land uses, comparatively to agroforestry systems where both are combined. Edges can then be viewed as a spatial discontinuity between two systems driven by two

distinct rates of disturbance. They have emerging properties which have to be analysed from the largest spatial scale when considering their contribution to landscape connectivity, to the finest scale when focusing on bio-physical fluxes between the two adjacent land covers. Forest edges have also their own dynamics leading to changes in location or in structure and species composition depending on different trajectories. Forest edges are components of land management being often associated with several other keystone habitat structures, such as ditches, rivers, roads, paths, but also with less visible social, cultural and historical limits. We argue that it is possible to use this general framework for identifying types of forest edges, drawing strong hypotheses about their functional significance and defining adapted management.

Population dynamics can be more important than climate change for determining future tree species distribution change in a temperate deciduous forest

Wen J. Wan, Hong S. He -School of Natural Resources, University of Missouri ; Frank R. Thompson III, USDA Forest Service, Northern Research Station; Jacob S. Fraser, School of Natural Resources, University of Missouri

Predictions of regional tree species distribution in response to climate change often rely on species-specific, niche-based models and plant functional types-based biophysical process models. These models usually simplify or ignore population dynamics (species demography and interaction) and harvest. We determined the relative importance of population dynamics, harvest, and climate change to tree species distribution in a 125-million ha Central Hardwood Forest Region of U.S. We used a forest landscape modeling approach to project changes in presence, density, and basal area of 23 tree species due to population dynamics, harvest, and four climate scenarios from 2000 to 2300. On average, population dynamics, harvest, and climate change explained 91, 7.7, and 0.2% of the variation in species presence at 2050, but their contribution changed to 61, 6, and 31% by 2300. Climate change led to substantial increases in the distribution of red maple and southern species (e.g., yellow poplar) and decreases in northern species (e.g., sugar maple) and most of widely distributed species (e.g., white oak). Harvest interacted with climate change and accelerated change in some species (e.g., increasing southern red oak and decreasing American beech) while ameliorated the changes for others (e.g., increasing red maple and decreasing white ash). We concluded that population dynamics was the primary driver of tree species distribution over the next 300 years. The effects of harvest were more important than climate change in the short term but climate change became more important than harvest in the long term.

Final Discussion & Wrap Up

Tobias Plieninger, University of Copenhagen; Schulp, Verburg

NULL

Landscape genetics for landscape ecology - setting the stage

Niko Balkenhol, Department of Wildlife Sciences, Georg-August-University Goettingen, Germany

Landscape genetics has undergone a tremendous growth and rapid development since its formal definition in 2003. While landscape genetic approaches have substantially contributed to research in ecology, evolution and conservation, several conceptual, analytical and practical issues remain. In this introduction to the symposium "Landscape genetics across space and time: contributions of molecular-genetic approaches to landscape-ecological applications", I summarize some of the major contributions that landscape genetics has made thus far, and also highlight the most important current challenges in

the field. Among the most prominent achievements of landscape genetics is a better understanding of the effects of the landscape matrix on successful dispersal and resulting population connectivity. Modeling of landscape resistances and the estimation of effective separation distances are key components for this and have received much attention. However, matrix resistance is not the only factor influencing realized genetic exchange, because the local environment can affect dispersal decisions, ecological differentiation and local adaptation. Furthermore, statistical issues associated with the use of pairwise landscape and genetic data have yet to be solved. To fully understand landscape genetic relationships, we need to derive testable hypotheses reflecting different landscape effects on genetic variation and underlying processes, design studies that specifically target the different hypotheses, and combine landscape genetics with other research approaches. Overall, I conclude that landscape genetics is currently diverging into two interrelated focal areas, with one emphasizing the use of genetics to understand ecological phenomena, and the other trying to understand the effects of spatial environmental heterogeneity on genetic variation.

Complex vegetation pattern arising from simple rules: a mechanistic explanation of vegetation composition in salt marshes using

Man QI, Tao SUN, Dongdong SHAO -State Key Laboratory of Water Environment Simulation, School of Environment, Beijing Normal University*

From the inception of plant ecology as an independent field, much attention has been focused on understanding spatio-temporal changes in vegetation. Due to the large variability of environmental stress in salt marshes, the key processes that dominate in vegetation composition may vary along stress gradient based on the stress-gradient hypothesis, resulting in the adoption of different types and extent of ecological processes for different stress values in the model simulation. In this study, we propose a universal model framework that addresses net interspecific interactions along stress gradient. Stress intensity, competitive ability and plant-soil feedbacks were accounted for in the framework. This developed framework was then applied to model the vegetation succession in a tide-restricted region in the Yellow River Estuary where vegetation composition and hydrological regime, such as soil salinity and waterlogging conditions, have been altered dramatically from 2001 to 2006. Simulation results identified the key factors that drove the alteration in abundance of each individual plant specie simulated and the response of the plant communities to varying hydrological regimes. We further applied this framework to natural salt marshes and studied interspecific interactions along stress gradients. The result showed that interspecific interactions were much more complex when plant communities containing three or more plant species were considered. This simple and universal framework enhanced our understanding in the variability of plant community along stress gradient, and will benefit the development of upscale model in salt marshes, which is subject to the notion that emergent vegetation patterns arise from simple rules.

Using models and maps of landscape-scale fire connectivity to mitigate the invasive grass-fire cycle

Miranda E. Gray, Conservation Science Partners; Brett G. Dickson, Conservation Science Partners; Valerie J. Horncastle, Northern Arizona University*

Landscape-level fuels management aims to minimize or fragment the risk associated with large and severe wildfires, and is increasingly important for preventing irreversible degradation to ecosystems. The strategic placement of fuel treatments is central to this objective, as some areas across a heterogeneous landscape may play a predictable role in facilitating or mitigating fire risk. Here we present a new approach to modeling the process of fire connectivity that can also guide fuel treatment placement where invasive Bromus grass (Bromus tectorum and B. rubens) is driving major changes to

native fire regimes and ecosystems in the western United States. On landscapes where Bromus has substantially contributed to increases in fire occurrence and spread, maintaining a fragmented distribution may increase ecosystem resilience to the invasive grass-fire cycle. In this context, we applied a circuit-theoretic model of fire connectivity to predict the centrality of Bromus patches in fire spread, and the most likely pathways of spread in two ecologically distinct regions of Arizona, namely the high-elevation woodlands of the Kaibab Plateau and the Sonoran Desert. Connectivity models based on circuit theory estimate the highly stochastic nature of fire spread and predict fire likelihood across large landscapes. We used spatially explicit outputs to inform the placement of fuel treatments that we analyzed in a modeling scenario. Overall, the centrality and fire likelihood of larger, contiguous patches of fuels dominated by Bromus decreased across the post-treatment landscapes. In turn, we discuss how the iterative application these methods can help guide ecologically and economically-strategic placement of fuels treatments.

Landscape genetics: opportunities and challenges for conservation

Janine Bolliger, WSL

In many parts of the world, human land use is the most important factor shaping landscapes. Many studies have shown a negative effect of intensive land use and management, low landscape heterogeneity and high fragmentation on species with likely detrimental consequences for ecosystems. Thus, conservation management has long recognized landscape and habitat fragmentation as a key topic of concern. Among many methods, landscape genetics offers information on basic questions of high conservation relevance such as how far does an individual/population spread in a larger spatial context, or on how species use landscapes, e.g., which landscape elements are likely corridors or obstacles. Although more than ten years have passed since the seminal paper in landscape genetics, the field has only just begun to evaluate the full range of possible analyses and opportunities to delineate management activities which relate to real-world situations. This presentation gives examples how landscape genetics may be efficiently implemented to delineate management actions and identifies challenges which are still date unsolved.

Influence of Fire and Postâ€fire Succession in Alpine Treeline Ecotones

C. Alina Cansler, University of Washington; Donald McKenzie, USDA Forest Service*

We assessed the impacts of wildfire on alpine treeline ecotones (ATEs) in the Pacific Northwest and Northern Rockies through a regional assessment of trends in the area burned and severity, and an analysis of forest structure and plant community using field data from >500 plots located in four burned field sites. Direct effects of climate change in ATEs include upward moving of treeline, while increase in the extent and severity of wildfires immediately decreases vegetation cover. Even if changes in climate allow faster recover after disturbance, the combined effects of increased tree establishment directly due to climate change, and increased tree mortality due to climate-mediated effects on disturbance regimes, are unclear. Regional area burn in ATEs from 1984-2012 followed trends in total area burned, implying that projected future increases in area burned will likely lead to increased area burned in ATEs. Using the field data, we found that the probability of burning and the severity of fire were highly spatially variable within ATEs. As forest cover decreased, probability of burning and severity decreased, reflecting limitations to fire spread in non-forest area within ATEs. On the other hand, seedling density was positively associated with burn severity in areas where there was a closed-canopy forest before the fire, but was positively associated with concave topography in areas with a more open or clumpy tree canopy. Overall, wildfires create a coarser, patchier pattern of forest and non-forest vegetation in ATEs, with high local variability in fire effects and post-fire tree establishment.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Green Infrastructure, Ecosystem Services and Hyperfunctional Landscapes

Thomas H. Whitlow, Ph.D., Section of Horticulture, School of Integrative Plant Sciences, Cornell University

The concept of green infrastructure recognizes that human wellbeing depends on multiple services performed by the biosphere. These services are either lacking or substantially diminished in cities. The current vogue of stacking and monetizing ecosystem services is popular because it captures value that has been neglected in traditional analyses and because it seems to offer a cost effective alternative to industrial approaches. This is especially true in the realm of air and water pollution. While monetizing ecosystem services is a welcome tool for raising consciousness, it poses these problems: 1) it assumes that our understanding is adequate and ignores uncertainty in the fundamental science, especially in generalizing across spatial and temporal scales; 2) it creates a false sense of having solved a problem with post hoc mitigation, thereby distracting attention from source abatement; 3) monetized values distract attention from the fundamental currencies like emission rates, pool sizes and fluxes; 4) natural processes require large amounts of space, a limiting resource especially in cities; 5) valuation based on the statistical value of a human life amplifies vanishingly small improvements in pollution. We illustrate these problems using examples of the effect trees have on air pollution in urban landscapes and by extension, human exposure at the scale of daily activity. We suggest that in order to achieve meaningful improvement in city environments, green infrastructure must be designed to be not just multifunctional, but hyperfunctional as well, because it is restricted to small spaces relative built infrastructure.

The ecology of foreclosure: Zooming in on urban plant biodiversity and its drivers under an economic disturbance

Julie Ripplinger(1) and Janet Franklin(2). 1 School of Life Sciences, Arizona State University. 2 School of Geographical Sciences and Urban Planning, Arizona State University*

When the housing bubble burst, followed by the Great Recession in 2008, the urban landscape was transformed. Foreclosures and abandoned development sites dotted metropolitan areas and unemployment rates spiked. This led us to ask: How did the drivers of urban vegetation change, from pre- to post-recession? Are annual species a suitable indicator of economic disturbance? The Phoenix metropolitan area houses nearly five million people and is among the fastest growing metropolitan areas in the U.S. We examined how residential vegetation changed under the boom-bust economics of the housing bubble and subsequent Great Recession. We monitored change in weedy indicator species abundance, measured changes in plant species richness, and identified drivers of vegetation change from 2000 to 2010 - a period that captures before and during the housing bubble, and after the Great Recession. Our results show that bottom-up drivers gain importance in the post-recession period (e.g. July maximum temperature, square footage of property, longitude). Both introduced and native annual richness increase during the housing boom, then decrease afterwards. Previous work has shown that a shift occurs from bottom-up to top-down controls on plant diversity along a desert-to-urban gradient. But we show that an economic disturbance is tightly linked to a decrease in management activities and accounts for the re-emergence of bottom-up controls on vegetation. It is well-understood how ecological processes shape plant communities in 'natural' systems, but this research is unique by demonstrating how an economic disturbance like the Great Recession can shape urban landscapes and plant community dynamics.

The definition of High Nature Value Farmland in Estonia

Kalev Sepp, Estonian University of Life Sciences; Robert Gerald Henry Bunce, Estonian University of Life Sciences; Tambet Kikas, University of Tartu; Ain Kull, University of Tartu; David Mccraken, Scotland's Rural College*

The concept of High Nature Value Farmland (HNVF) has been widely accepted as valuable in the context of strategic planning for maintaining traditional agricultural systems linked to high biodiversity. However there are problems with its definition due to the limitations of European databases at local levels. Thus in Estonia it was established that the European map of HNVF included areas with no agriculture and that the data on land cover classes was in insufficient detail. Accordingly a project was set up by Government to examine how the distribution of HNVF could be improved in Estonia. An expert group then identified 15 indicators of HNVF that were consistently available for the whole country and were in greater detail than was available for the entire EU. These indicators will be listed in the paper and were identified in response to the literature on HNVF, which describes the parameters which are linked to biodiversity on farms, such as linear features and landscape mosaics. The former was measured directly from topographic maps and the latter by the Simpson Index which includes measures such as small woodlands and belts of trees. These data were then analyzed by statistical procedures in order to determine the relationships between them. These analyses will be summarized in the paper. It was also concluded that an expert system was required to produce a new Estonian map of HNVF, rather than an index, because the parameters are on different scales and need different weights.
The new map of HNVF in Estonia will be presented and compared with the version produced for the whole of the EU. In addition, examples of the inconsistencies will be described.
It is concluded that a further initiative is required in Europe to identify and integrate national databases to produce a map with more detail for strategic planning across national frontiers.

Synergistic effects of climate and land-cover on 30-year bird population trends of the northwestern USA

Matthew G. Betts Dept. of Forest Ecosystems and Society, Oregon State University, USA; Yang, Z., Dept. of Forest Ecosystems and Society, Oregon State University, USA ; Gutierrez Illan, J., Dept. of Forest Ecosystems and Society, Oregon State University,*

Climate and land-use change are predicted to lead to widespread changes in animal population dynamics, but quantitative predictions on the relative effects of these stressors have not yet been tested empirically. We analyzed historical abundance data of 110 terrestrial bird species sampled from 1980 - 2010 along 450 Breeding Bird Survey (BBS) routes across the northwestern USA. Using boosted-regression trees, we modeled bird abundance at the beginning of this interval as a function of (1) climate variables, (2) Landsat-derived land-cover data, (3) the additive and interactive effects of climate and land-cover variables. We evaluated the capacity of each model set to predict observed 30-year bird population trends. On average, 45 species significantly declined over the period observed and only 8 increased (mean trend = -0.84%/year). Climate change significantly predicted observed abundance trends for 56/110 species (mean r=0.40Â±0.17 [SD]), land-cover changes alone predicted trends for only 32/110 species (mean r=0.37Â±0.10), and synergistic effects predicted 42/110 species (mean r=0.43Â±0.11). Across stressors, species with trends that were predicted accurately were more likely to be in decline across the northwest; abundance models therefore have the capacity to predict the species most likely to be at risk from climate and land-use change on the breeding grounds. Our results highlight that climate change has already influenced bird populations of the northwestern U.S., and that such effects often operate synergistically with land-cover change to affect population declines.

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Beyond the mean: understanding potential climate-related impacts of changing natural fluctuations of environmental regimes on trout populations from coastal streams

*Ivan Arismendi * Oregon State University, Department of Fisheries and Wildlife; Brooke E. Penaluna USDA Forest Service, Pacific Northwest Research Station*

Recent warming of terrestrial climates around the world has motivated concern about consequent alteration of riverine ecosystems. Increasing evidence suggests that future shifts in environmental regimes are not simply a monotonic change on central tendency metrics such as increasing average stream temperature. Instead, expected changes in the frequency and variability of extremes events could affect the stability of populations and thus, their persistence over time. Unfortunately, long-term time series of species abundances are scarce and thus, the potential impacts of future climate change at the population-level have been overlooked. Here, we explore the role of varying natural fluctuations of environmental regimes on the stability of stream-trout populations. Using an individual-based model approach we run simulations from 64 single and combined scenarios of changing variability of flow and temperature in streams, but keeping similar average conditions. Under conditions of stream temperature that did not exceed trout physiological limits we find that the biggest constraint on population abundance and biomass during summer is available habitat (i.e., baseflow). In addition, overwinter mortality of trout is directly related to high flow and reduced growth occurred due to colder streams. Our mechanistic modeling approach demonstrates how sensitive populations are to hydroclimate extremes across seasons providing insights to successful ecological forecasting. This has important conservation implications given the risk of local extinctions may increase due to expected global environmental change.

Fuel treatment planning to minimize the loss of ecosystem services: a case study on the Deschutes National Forest, Oregon

Jason Kreitler, WGSC, USGS; Matt Thompson, RMRS, USFS; Nicole Vaillant, WWETAC, USFS;*

Wildland fire activity in the western United States has increased dramatically over the past decade. This trend will likely continue in fire prone ecosystems due to legacy effects of fire suppression and management, and an increasing influence from prolonged drought and climate change. Fuel treatments are often the primary pre-fire mechanism to reduce wildland fire hazards, and a growing suite of fire models and tools are employed to prioritize treatments. To include ecosystem services in fuel treatment planning, we model biomass as a proxy for the climate regulating ecosystem service of carbon storage, and sediment retention as a contributing factor to water quality, in a case study of the Sisters Ranger District of Central Oregon. Our objective is to maximize the averted loss of ecosystem service benefits subject to a fuel treatment budget. We model fuel treatment costs across the study landscape to introduce cost-effectiveness in fuel treatment planning. We test four prioritization algorithms and measure the effectiveness of each algorithm in ecosystem service terms by comparing the differences between treatment and no treatment scenarios. Two algorithms prioritize treatments based on cost-effectiveness and show small to substantial gains over those using only benefits. A larger effect of incorporating cost-effectiveness is the ability to treat up to 25% more area for the same budget. Variations in the heterogeneity of costs and benefits create opportunities for fuel treatments to maximize their expected averted loss. By targeting these opportunities we demonstrate how incorporating mapped ecosystem services and costs can improve the outcome of fuel treatment planning.

Differences in land cover change across the communities with and without Returning Farmland to Forest Program in Weixi County, China

Zhang Zhiming, Institute of Ecology and Geobotany, Yunnan University, Kunming, China; John Zinda, Institute at Brown for Environment and Society, Brown University, Providence, RI, USA.*

China's Returning Farmland to Forest Program (RFFP, or called Sloping Land Conversion Program), introduced in 1999 and implemented nationwide in 2001, is the largest compensated reforestation program in the developing world. Farmers receive compensation for retiring marginal farmland and planting trees, with goals of erosion control, carbon sequestration, and habitat enhancement. While numerous studies examine broad land cover impacts of the program, local-scale heterogeneity has received little attention. This study examines land cover change in communities that did and did not participate in the program. The study area, Weixi County, is located in the Lancang (Mekong River) watershed, within the Hengduan Range of the eastern Himalayas. With altitudes ranging between 1500m and 4500m, the area is typical of montane landscapes of southwest China. In this study, we hypothesize that communities participating in RFFP experience greater increase in forest cover than those communities without RFFP and that density and species richness of non-RFFP forests are greater in participating communities as well. We assessed these hypotheses in twelve communities along an elevation gradient, five with and seven without RFFP, using remote sensing data (from 2000 to 2010) and field measurements in forest quadrats. Initial results indicate that there is no significant difference in forest land cover change in communities with and without RFFP participation. In analyses underway, we are examining data from a household survey and a set of community focus groups to account for factors explaining differing afforestation outcomes and varied land cover trajectories in the twelve case study sites.

Landscape Impacts of Mountaintop Mining in the Appalachian Mountains --- State of our Knowledge and a Path Forward

Matthew C Nicholson, U.S. Environmental Protection Agency (EPA); James Wickham, U.S. EPA; Petra B Wood, U.S. Geological Survey; Michael Strager, West Virginia University; Christine Mazzarella, U.S. EPA; William Jenkins, U.S. EPA

Mountaintop-removal mining (MTRM) is similar to other surface mining practices in that the overburden of soil and rock are removed to expose the coal. However, it is distinct in its scale with as much as 300 meters of overburden removed to access coal seams. Beyond the loss of topographic complexity, MTRM leads to numerous impacts on both the aquatic and terrestrial environments. Many of these impacts are evident such as complete loss of streams and stream habitat, however many of these impacts are often overlooked or inadequately addressed, such as cumulative impacts. To determine potential research needs, we reviewed the recent research on MTRM by the authors and others and examined the decision context in which this information may potentially be used. Based on this assessment we identified several important knowledge gaps. We review these gaps and suggest how landscape ecological studies can fill this void.

Assessing suburban growth and their influence on watershed ecosystem services for NYC metropolitan area.

Henry N. N. Bulley, Borough of Manhattan Community College, City University of New York

There are growing concerns about threats to ecosystem services derived from lakes and reservoirs due to human activities and climate change. These include nutrient enrichment in agricultural areas, and habitat loss due to urban sprawl. This presentation draws from my research experiences with nutrient enrichment of source water protection for densely urbanized areas in the Northeastern United States. In particular, it will focus on water supply reservoirs and lakes in Croton and Catskill/Delaware

watersheds. New York City embarked on a historic Watershed Agreement in1997 with multiple stakeholders with the goal of protecting the quality of these reservoirs. The approach was based on protecting watershed and water ecosystem services at a fraction (about $1.5 billion) of the cost of about $8 billion needed to build a water filtration plant to clean the water supply. Many consider New York City's watershed scale ecosystem approach as an economic success story. However, there are looming questions about gradual suburban expansion the watershed area and changing agricultural activity due to increased emphasis on locally grown produce by urban dwellers. Preliminary results from a land use change analysis in the water supply watersheds suggest increasing fragmentation of the landscape. I will discuss the driving forces of these changes and highlight their linkages with 3 measures of water quality (ecosystem service), namely total nitrogen, total phosphorus, and suspended solids. This is useful decisionâ€support information for water managers, as many more urban cities in the United States, look to adopt New York Cityâ€™s ecosystem approach to providing safe drinking water and recreation.

Urbanization in the Shanghai-Yangtze River Delta Urban Agglomeration (SHYRDUA), China: Its trajectories, landscape impacts, and ecological effects

Ji Han, Wei-Ning Xiang, Ying Chen - Shanghai Key Lab for Urban Ecological Processes and Eco-Restoration, School of Resources & Environmental Sciences, East China Normal University, Shanghai, China*

As China's largest and world's 6th urban agglomeration, Shanghai-Yangtze River Delta Urban Agglomeration (SHYRDUA) is one of the most densely populated and rapidly developed areas in the world. While having become the most important powerhouse of China, it also suffers from a tremendous amount of growth pains such as the dramatic change of landscape, and the decline of ecosystem's quality, resource and energy depletion. Thus, for the important roles it has been playing in the past hundred-year urbanization processes, SHYRDUA has become one of the common focuses of both scholars and practitioners. We are interested in exploring the following three questions: 1) What are the changes in urban population, per capita GDP, and per capita CO2 emissions over the five decades between 1960 and 2010? 2) To what extent and exactly how have the rapid and massive urbanization processes changed the region's landscapes since 1990s? 3) What effects have urbanization induced on the region's carbon emissions and sinks? By answering the questions we aim at having an in-depth understanding of the processes, landscape change and ecological effects of urbanization in SHYRDUA, which are unique but will provide synthetic insights for growth management and sustainable planning.

Integrated Landscape Conservation of Traditional Agricultural Regions in Urban Agglomeration: Case Study of Uji Tea Growing Region

Monte Cassim, Ritsumeikan University; Tahahiro Ota, Ritsumeikan University; Xuepeng Qian, Ritsumeikan Asia Pacific University*

The landscape conservation is always a big concern in the development of urban agglomeration, especially when cultural issues are involved. Uji, located at Keihanshin Metropolitan area, is the place where Japanese tea culture originated over 800 years ago. Uji has ideal climatic conditions and water resources which are essential for the cultivation of good tea. Through the landscape conservation project of Uji tea growing region, this study aims to create the knowledge commons for sharing the landscape conservation information obtained as follows. First, we collected and analyzed the fundamental factors for landscape conservation by using ICT, such as one original application software in mobile devices for plant information recording. We worked on the catalogue of teas and other plants

that form the landscape and the database of environmental factors that influence the landscape in Uji. Second, we designed the knowledge creation and inheritance system in partnership with local communities and conducted education and training programs supported by junior and high schools in order to raise the citizens' awareness. It proved the effectiveness of transdisciplinary collaboration and community participation in urban development and provided a method that helped to improve the efficiency of such communications by utilizing digital devices and cloud service. Furthermore, we integrated landscape conservation measures in the project and proposed it as a systematic solution named 'Human-Expert Cloud service (HECS) '. It is also expected to promote the sustainability of the traditional agriculture in the progress of urban agglomeration.

From administration to indication: Using an administrative database to localize and characterize High Nature Value farmland (HNVf)

Ã‚ngela Lomba, CIBIO - Research Center In Biodiversity and Genetic Resources, Portugal; Michael W. Strohbach, Humboldt Universitat zu Berlin, Department of Geography, Germany; Sebastian Klimek, Thunen Institute of Biodiversity, Germany*

Drawing attention to the declining species-rich farmland of Europe, the High Nature Value farmlands (HNVf) concept was introduced 20 years ago. Today, HNVf relevance for nature conservation and rural development is acknowledged by policy-makers in the European Union (EU). First attempts at characterizing, localizing and monitoring HNV farmland on EU, national and regional level have been made, but many challenges remain. Among them is the lack of suitable and meaningful farming systems data, i.e. information on farming practices that enhance farmland biodiversity. The Integrated Administration and Control System (IACS) was adopted by the EU in the early 1990's to improve the efficiency of payments under the Common Agriculture Policy (CAP). By registering data on farm and agricultural parcel level, IACS constitute a comprehensive database regarding essential indicators that could be used to assess HNV farmlands. Here, we test the suitability of IACS data to extract spatially-explicit indicators required to assess the location and extent of HNVf in Lower Saxony, Germany. We advocate that IACS data have the potential for characterizing, localizing and monitoring HNV farmland, which is essential to accurately assess impacts of agricultural policies.

Combining connectivity modelling and systematic conservation planning approaches to assess the cumulative impacts of mining.

Alex M. Lechner, Centre for Environment, University of Tasmania, Australia; Centre for Social Responsibility in Mining, University of Queensland; Heini Kujala, Amy Whitehead - Centre of Excellence for Environmental Decisions, The University of Melbourne,*

Conservation planning aims to identify the most effective and efficient way to conserve and maintain biodiversity. We explored ways of combining tools from two well established but somewhat independent fields of systematic conservation planning, connectivity modelling and spatial prioritization. We compare and combine the outputs from: i) graph metric least-cost path modelling, ii) the spatial prioritization tool Zonation (v.4.0) and iii) Zonationâ€™s distribution smoothing technique which is used to generate aggregated reserve networks. We used a case study in the Lower Hunter, Australia, assessing the cumulative impacts of mining to illustrate the differences between these approaches. Connectivity was modelled using a dispersal cost-surface, where mines represented dispersal barriers. Our study revealed that reconciling graph metric least-cost path approaches with complementarity based spatial prioritization tools is challenging due to their different ways of representing habitat. Zonation represents landscape as continuous raster values, while graph-metric approaches represent landscapes using the discrete patch-matrix landscape abstraction. We found that the ecological details

of dispersal were better captured by graph metric least-cost path while Zonationâ€™s corridor modelling approach was more representative of broad-scale regional wildlife corridor initiatives where the focus is on connecting whole landscapes, not just connecting patches. Of the approaches tested, we found that identifying conservation solutions that are a combination of high biodiversity priority Zonation area connected by least-cost paths provide a new novel method that combines both approaches. This study addresses some of the difficulties encountered by land managers that often need to balance the needs of the competing conservation targets of increasing connectivity and identifying the most important locations for biodiversity protection.

Assessing Ecological Benefits for the California Department of Water Resources: Incorporating Landscape Pattern into Habitat Evaluation Models

Michael Yun, AECOM; John Hunter*, HT Harvey and Associates*

The California Department of Water Resources has committed to enhancing ecological function within the Central Valley flood system as a component of their newly adopted Integrated Water Management approach. They have authored a comprehensive Conservation Strategy report which lays out specific ecological objectives including; restoring ecological processes, eliminating stressors, improving target habitats and benefitting target species. In order to optimize planning to meet those ecological objectives, we have developed a tool which quantifies the ecological benefits of the proposed restoration actions and scores aggregated configurations of these actions so that decisions makers can compare and contrast suites of projects. This modeling tool has two primary components; one quantifies general ecosystem quality for target habitat typologies and the other quantifies the potential benefit of those habitats to the associated target species. This presentation will describe the methodology used to develop a tool that quantifies these benefits in a way that is compatible with the US Army Corps of Engineers and US Fish and Wildlife Services federally reviewed evaluation techniques.

Modeling Urban Retreat toward Sustainability by integrating the index of Quality of Life with Cellular Automata

Ji Han, East China Normal University*

In mega-cities with high population density, insufficient natural resource supply, and limited environmental capacity, the intensive utilization of urban land would play a dominant role in realizing the whole city's sustainable development. The ill planned urban development of most China cities in the past decades was usually achieved by the extensive sprawl of urban built-up land while with the loss of cropland and green land, which is recognized as unsustainable and needs an essential shift from unplanned sprawl to sustainable retreat. For city planners, where should the urban land be retreated and what are the benefits that retreat will generate are the primary questions need to be answered. In this paper, we propose a modeling tool by integrating the index of quality of life with cellular automata to support the urban retreat strategy, and apply it in one of the largest cities, Shanghai, in China to ensure its efficient use of urban land and improvement of local citizen's quality of life from 2010 to 2040. The insights into spatio-temporal distribution of land use/cover and quality of life will be useful for urban development management planning and decision-making.

Topic: Dynamics of peri-urban land use changes in West Africa: a comparison of Ibadan (Nigeria) and Accra (Ghana)

Felicia Akinyemi (1) and Henry N. N. Bulley (2) 1 - Dr. Felicia Akinyemi Associate Professor - Environmental Science (Climatology/GIS & Remote Sensing) Department of Earth and Environmental Science, College of Sciences Botswana International University

Sub-Sahara Africa, like many other regions have been experiencing rapid urban growth In particular, recent economic growth in emerging economies of Sub-Saharan African countries such as Nigeria and Ghana brings additional pressure on regional planning for sustainable development. In Ghana, urbanized areas accounted for about 44 percent of the country's population in 2000 whereas it is 60 percent in Nigeria. This presentation examines the urban growth in Accra Metro area (Ghana) and Nigeria's third largest metropolitan area, Ibadan since the 1980's period of economic stagnation in both countries. Our assessment involved integration on GIS and remote sensing techniques to examine historical LULC change and explore the drivers of these changes in especially peri-urban areas. Our initial assessments indicate significant increases in the urban land use areas in both Accra and Ibadan metro areas. These land use changes were anticipated, and follow the economic development trends of both cities. For our presentation, we will link and discuss the directions and extent of peri-urban changes in land use characteristics. This study contributes to the understanding of LULC change and the underlying processes of change in two of Africa's urbanizing areas. Understanding these drivers of peri-urban change in Sub-Saharan Africa is vital to sustainable regional planning and development.

Eco-Evolutionary Dynamics in Urban Landscapes: Emerging Hypotheses and Research Strategies

Marina Alberti, Urban Design and Planning, University of Washington

A fundamental question in ecology for the coming decades is what role urbanization plays in shaping planet-scale rapid evolutionary change. Urbanization is a major driver of micro-evolutionary change. Changes in ecological patterns and processes associated with urban development alter biodiversity both by reducing the number and variety of native species and by changing species' cultural and genetic makeup. There is increasing evidence that anthropogenic change leads to evolutionary change in species traits that, in turn, alters ecological interactions for many organisms including arthropods, birds, fish, mammals, and plants. In this presentation, I examine current evidence linking urban landscape patterns to rapid evolutionary changes for species that play an important functional role in communities and ecosystems and for maintaining their stability over time. I then present an integrated framework to identify key mechanisms linking urban ecosystem dynamics to eco-evolutionary feedback. I hypothesize that humans mediate eco-evolutionary dynamics in subtle ways by introducing changes in habitat, biotic interactions, heterogeneity, novel disturbance, and social interactions. The presentation closes by addressing research challenges and opportunities to tackle such question in innovative and productive ways. I advance that by studying how human-driven micro-evolutionary changes interact with ecological processes will provide important new insights for maintaining biodiversity and ecosystem function over the long term.

Applications in forest landscape ecology: evolution, progress, and challenges

Ajith H. Perera and Lisa J. Buse, Ontario Forest Research Institute, Canada*

The last several decades have seen a notable expansion and growth in the science of forest landscape ecology. In many instances those scientific concepts have been embedded in applications for managing forest landscapes under various environmental, social, and economic contexts. These applications range from developing strategic forest management policies to tactical problem solving with multiple issues, for example changing contexts and values, demands for ecosystem services, and effects of emerging forest management goals. This progress has been aided by advances in technology and education. In this presentation, we: 1. briefly review the evolution of forest landscape ecological applications, 2. discuss the past, present, and future challenges to continued progress, and 3. examine the many roles and responsibilities that landscape ecologists have to assume for continued growth and expansion of

applications in forest management. In particular, we focus on aspects such as parsimony, scale appropriateness, and clarity in developing applications, as well as the increasing need for effective knowledge transfer.

Landscape Characterization, Spatial Heterogeneity, and Community Forests in Kailash Sacred Landscape (KSL)-India

Sweta Singh, Wildlife Institute of India; Bhupendra Singh Adhikari, Wildlife Institute of India; Gopal Singh Rawat, Wildlife Institute of India; Pradeep Kumar Mathur, Wildlife Institute of India*

Present study forms a part of Himalayan transboundary landscape (Kailash Sacred Landscape-KSL) aimed to develop innovative approaches for twin goals i.e. conservation and development. Study specifically focuses on KSL-India component and developed understanding on spatial heterogeneity for effective management. In addition, an insight on community forests and their surrounding lands forming 'matrix' was also developed. Study was carried out in KSL-India encompassing 7,120 km2. Land Use/Land Cover map in GIS domain was generated. Software FRAGSTATS v.4.2 was used for quantifying landscape structure and computing various metrics. Computed metrics/indices characterized the landscape mosaic as a whole, patch type (class), and each patch type. Spatial heterogeneity was also assessed for the predetermined 'Horizontal Transect' and its surrounding area. Preliminary findings provided an insight for the entire landscape, sub-watersheds, and different forest Ranges. Pithoragarh and Bageshwar districts constituted 96% and 4% area of the landscape, respectively. 41.5% area of the landscape in the northern part was snowbound. Glaciers constituted the second largest category of land cover and occupied 10.77% area of the landscape. Human and agro-ecosystem dominated 'matrix' contributed 17.6% area of KSL-India. 18 different forest types covering 2,127.27 km2 represented nearly 30% of the landscape. Three Oak (Quercus spp.) forest types occupied 1,064.16 km2 area of KSL-India or represented almost half of the forested tract. Paper also discusses spatial heterogeneity on the basis of 9,392 patches under 22 land use/land cover categories deciphered.

A Spatial Framework for Understanding Population Structure and Admixture

Gideon Bradburd, UC Davis; Peter Ralph, USC; Graham Coop, UC Davis*

Geographic patterns of genetic variation within modern populations, produced by complex histories of migration, can be difficult to infer and visually summarize. A general consequence of geographically limited dispersal is that samples from nearby locations tend to be more closely related than samples from distant locations, and so genetic covariance often recapitulates geographic proximity. We use genome-wide polymorphism data to build "geogenetic maps", which, when applied to stationary populations, produces a map of the geographic positions of the populations, but with distances distorted to reflect historical rates of gene flow. In the underlying model, allele frequency covariance is a decreasing function of geogenetic distance, and nonlocal gene flow such as admixture can be identified as anomalously strong covariance over long distances. This admixture is explicitly co-estimated and depicted as arrows, from the source of admixture to the recipient, on the geogenetic map. We demonstrate the utility of this method on a global sampling of human populations, for which we largely recover the geography of the sampling, with support for significant histories of admixture in many samples. This new tool for understanding and visualizing patterns of population structure is implemented in a Bayesian framework in the program SpaceMix.

Spatial and temporal dynamics of a biodiversity-based cultural ecosystem service in the Southern Appalachians

Rose A. Graves, Department of Zoology, University of Wisconsin, Madison, WI; Scott M. Pearson, Department of Natural Sciences, Mars Hill University, Mars HIll, NC; Monica G. Turner, Department of Zoology, University of Wisconsin, Madison, WI*

Cultural ecosystem services i.e., non-material benefits received from nature, contribute substantially to nature-based economies in rural regions and may be especially impacted by shifts in land use. In regions experiencing exurban transitions, incomplete knowledge of the links between land-use patterns, biodiversity, and ecosystem services can lead to unintended losses of biodiversity-based cultural ecosystem services. We measured wildflower communities at 60 sites across a rural-to-urban gradient in the French Broad River Basin, North Carolina to establish the spatial-temporal distribution of wildflower blooms, which represent a biodiversity-based cultural ecosystem services (wildflower viewing). Few studies assess wildflower phenology at the full community-level and seldom examine flower communities from a resource availability and anthropogenic perspective. We asked: (1) what factors influence the distribution of wildflower blooms across the landscape? and (2) how do spatial patterns of a biodiversity-based cultural ecosystem service change within the spring to late-summer seasons? We recorded over 200 species flowering from April to August 2014. The number of species in flower across all sites averaged 17 (CV= 0.71) and exhibited strong seasonal and spatial variation, with total flower availability peaking during early summer. The abundance of wildflower blooms was highest at moister sites with lower tree basal area, longer growing seasons and lower precipitation. Number of species in flower declined over the season and with increasing building density. The spatial-temporal distribution of wildflower blooms provides insight into relationships between cultural ecosystem service provision and land use in exurbanizing landscapes.

Tracking two decades of vegetation change across the sagebrush landscapes of Upper Gunnison Basin, Colorado: Linking field re-measurements, remote sensing, and climate data

Jonathan Coop, Western State Colorado University; Daniel Piquette, Oregon State University*

Across the western US, sagebrush ecosystems have been altered by invasive species, changing fire regimes, land use practices, and climate. In the Upper Gunnison Basin, sagebrush landscapes form critical habitat for ca. 80% of the remaining population of Gunnison Sage-grouse. The purpose of our research was to assess recent vegetation dynamics in these landscapes via linkages between field samples, remote sensing, and climate data. During the summer of 2014, we re-measured over 100 vegetation transects originally established in the 1990's, stratified across the full range of sagebrush communities in the basin. We also developed corresponding time series of 30-m resolution growing-season NDVI from Landsat imagery and 4-km resolution interpolated climate data. We observed pronounced, basin-wide dieback of sagebrush across all sagebrush taxa (Artemesia nova and four subspecies of A. tridentata). Live sagebrush canopy cover decreased from 29.4% to 23.0% ($P<0.001$). Along with a corresponding increase in dead cover (from 7.3 to 13.0%; $P<0.001$) and associated shifts in plant community composition, these patterns were consistent with landscape-scale responses to recent drought. Variation in cover and composition were associated with seasonal and interannual trends in NDVI, which were closely linked to models of precipitation and temperature. These cross-scale relationships have implications for long-term strategies for conservation of sagebrush habitats and the species that depend on them, including future responses to projected climate change.

Nitrous oxide emissions from denitrification in a mountain subtropical forest in Mexico

Conrado M. Guzman-Flores, CINVESTAV-IPN; Victor Jaramillo, CIEco UNAM; Jose Antonio Vera-Nunez, CINVESTAV-IPN; Juan Jose Pena-Cabriales, CINVESTAV-IPN*

Mountain subtropical forests cover 16% of the Mexican landscape, and are primarily composed of oak-pine communities. Despite the global need to quantify nitrous oxide (N2O) emissions associated with deforestation and land use change, there is a lack of measurements for mountain subtropical forests worldwide. To our knowledge this is the first quantification of N2O emissions from denitrification processes in an oak-pine mountain forest in Mexico. Our goal was to determine the environmental factors and microbial populations that contribute to N2O emissions by denitrification through an established altitude gradient (3200-2650m) in four levels of vegetation cover: Oyamel (Abies religiosa), Oak (Quercus spp.), transition shrubs, and annual grasses. Three measurements and samplings for each level were made during the late rainy season from September to November 2014. Total N2O emissions where measured in situ through static chamber technique, and N2O emissions by denitrification were measured by the acetylene inhibition method from intact soil cores. Microbial populations were obtained from nitrate selective medium to test for denitrification activity, and isolates were identified through 16S. Annual grasses display highest soil temperature (18Â°C), highest bulk density (1.48g/cm3), and lowest soil porosity (43.85%). Oyamel displays highest soil organic matter (73.4g/kg), soil water content (59.12%), and highest microbial activity through CO2 production (148mgO2/kg*h). Data and conclusions will be discussed during the oral presentation.

The City Biodiversity Index (CBI) of the CBD: Striking a balance between practical applicability and scientific rigour

Jochen A.G. Jaeger, Concordia University Montreal

The City Biodiversity Index (CBI) was developed as a relatively simple and practical tool for evaluating the state of biodiversity and ecosystem services in cities and for improving conservation efforts. The CBI was proposed at the 9th Meeting of the Conference of the Parties (COP-9) to the Convention on Biological Diversity (CBD) in 2008, and developed in three expert workshops in 2009-2011. It includes 23 indicators, organized into three groups: native biodiversity, ecosystem services, and governance and management. The CBI was designed to be easy to apply, scientifically sound, objective, and fair, resulting in a trade-off between practical applicability and scientific rigor. The CBI has been criticized as both too complicated for cities who do not have much GIS expertise and too simplistic because it is based on several simplifying assumptions. Since the CBI is supposed to be applied by many cities, pushing for more scientific rigor may result in a refusal of most cities to use it. The CBI includes a profile of the city to supplement the 23 indicators, where more information can be included by cities that have the capacity for more rigorous investigations. A future version of the CBI should encourage the reporting of information at multiple levels of scientific soundness in parallel, while the 23 indicators serve as a basic version for all cities to get started.

Sea Level Rise: Biodiveristy Impacts and Adaptation Strategies

Mingjian Zhu, University of Florida; Tom Hoctor, University of Florida; Mike Volk, University of Florida; Anna Linhoss, Mississippi State University

Sea level rise and land use change are likely to be some of the most fundamental and important challenges for biodiversity conservation in low-lying coastal areas in the 21st century. To protect biodiversity in coastal areas, there is an urgent need to identify conservation priorities in response to sea level rise and land use change. In this study, we demonstrate an integrated modeling process using a geomorphological model (SLAMM), species habitat models, and conservation prioritization (Zonation) to identify conservation priorities in the face of sea level rise and land use change. We present a case study in the Matanzas River basin of northeast Florida that utilizes this integrated modeling approach with data for 38 focal species. We incorporate species-specific connectivity requirements in the analysis and

compare the multi-species spatial prioritization with existing conservation datasets including current conservation and managed areas and the most recent version of the Florida Ecological Greenways Network (FEGN). Results show that current reserves are not adequate to protect the most important conservation priorities as sea level rises but that the updated FEGN does serve as a good foundation to inform future conservation decisions relevant to sea level rise. We demonstrate how the priorities identified through our integrated modeling process can be used to expand the current reserves and create new conservation areas in response to sea level rise. Finally, we demonstrate how future development projections can be integrated into the planning process to achieve the goal of balancing future development with conservation and other priorities.

Extending spatial scaling theory to new disciplines: phylogenetic scale in ecology and evolution

Catherine Graham, Stony Brook University, New York; Antonin Machac, Stony Brook University, New York ; David Storch, Charles University & Academy of Sciences of the CR

It is well-established in ecology and evolution that spatial scale can influence biogeographic patterns. By contrast, our understanding of the effects of phylogenetic scale is undeveloped even though many fundamental questions in biogeography are currently addressed using phylogenetic information. Recognizing this is important because all research using phylogenies implicitly choses a scale which can dictate the patterns observed and, therefore, the inferences made about mechanisms generating these patterns. Here we use definitions and theory developed with respect to spatial scaling to explicitly define phylogenetic scale. Spatial scale is often defined in terms of grain (the resolution of the smallest area being used in analyses, i.e., grid cell) and extent (the size of the geographic area being assessed). Much like spatial grain, phylogenetic grain is the smallest unit that is being analyzed and is defined based on a particular depth or time interval in the phylogenetic tree. Phylogenetic extent is the size of the entire phylogeny used to address a given question. We show how explicitly considering phylogenetic scale, and potentially evaluating multiple phylogenetic scales, allows us to reconcile outstanding disagreements about the processes causing pattern in spatial ecology. We also evaluate how phylogenetic scale is currently considered across research areas ranging from phylogenetic community analysis to macroecology to evolution, and suggest how an explicit consideration of phyologenetic scale can unite these fields.

Cumulative Stressor Index: Planning for Environmental Change in Alaska

E. Jamie Trammell, University of Alaska, Anchorage*

Rapid environmental change is no more apparent than in northern latitudes. Part of what makes planning for rapid change challenging is the understanding that no single stressor will act independently of others. Understanding the potential magnitude of change is highly uncertain, yet essential for land managers developing plans for the next 20 years. This desire to gauge potential impacts has led to the recently developed "landscape approach" by the U.S. Department of Interior. Rapid Ecoregional Assessments (a key part of the landscape approach) provide an opportunity to assess multiple stressors for an ecoregion. I present here a simple GIS-based model that provides a cumulative stressor index (CSI) so managers can monitor, and plan for, areas that are likely to change the most. Although not targeted on any specific social or ecological resource, the CSI provides an opportunity to prioritize monitoring locations, experiment with adaptation strategies, and gauge the magnitude of environmental change expected on their lands. Additionally, when combined with a working understanding of ecological intactness, CSI can help identify those areas most likely to be resilient to climate and human disturbances. I provide two examples from Alaska (boreal and arctic) showing the flexibility this approach has to different systems.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Business as innovators in social-ecological transitions to sustainable landscapes: the case of the Dutch Heineken brewery

Paul Opdam, Alterra Wageningen UR; Eveliene Steingrover, Alterra Wageningen UR; Menko Wiersema, Province of South Holland; Jan Kempers, Heineken Netherlands

We consider the possible role of large enterprises as a driver of transformations in land use towards sustainability. Sustainable use of land is understood as the inclusion of landscape services in regionalized cyclic flows of energy, water and nutrients. We apply the concept of the social-ecological network, in which demanders for landscape services are connected to suppliers by means of the ecological network of the landscape, which provides a multitude of potential services. Demanders are actors that benefit from landscape services, including citizen groups, local and regional governments and enterprises. Suppliers are land owners, including farmers, which may intervene in the landscape to improve service provisioning. Demanders invest in services, in money, in time or in matter. The transformation we aim for is an increase in the interactions within this social-ecological network. We show how the demand by a large enterprise may cause such an increase and how this may produce added value to society. On the other hand, we suggest that the regional government has an important role to play in accelerating the transformation. Examples are taken from a currently running transition experiment in which a large brewery of Heineken is supposed to be a driver of transition.

Modeled impacts of land use decisions on highly fragmented and dispersal-limited species in the Southern Willamette Valley, Oregon

Cody R Evers, Portland State University; Gwynne A Mhuireach, University of Oregon; Bart R Johnson, University of Oregon.*

Anticipating the impact of future land use decisions on sensitive wildlife is a challenge for conservationists, land managers, and land-use planners. Such challenges are especially pronounced in rapidly urbanizing regions, such as in the Willamette Valley, Oregon, which contains some of the most imperiled ecosystems in North American. Due to amount of privately owned land, voluntary cooperative and careful land use planning key to long-term conservation in the Valley. We examine the impact of growth control and voluntary restoration programs on the maintenance and restoration of critical habitat for two imperiled species: the White-Breasted Nuthatch, a state-listed bird that depends on highly-fragmented oak woodland, and; the Fenders Blue, a federally-listed butterfly that depends on the presence of a specific (threatened) host plant in prairies and savannas. To accomplish this, we combined an agent-based simulation of each species' life history with a spectrum of alternative landscape futures that were generated through an integrated simulation of rural/urban development, forest succession, and natural/artificial disturbance. Results show that each species' life history characteristics lead to very different degrees of responsiveness to the quantity and distribution of habitat created, as well as challenges of conserving multiple species with different habitat needs in a related set of rare ecosystem types. We discuss implications in terms of voluntary incentive programs, private-landowner restoration, and existing conservation frameworks. Our methods and findings are relevant to species conservation, restoration and land management in areas that are near urban centers and experiencing development pressure.

Green infrastructure strategies for climate change and the promotion of biodiversity in urban areas

Stephan Pauleit, Chair for Strategic Landscape Planning and Management, Technical University of Munich; Teresa Zolch, Centre for Urban Ecology and Climate Change Adaptation, Technical University of Munich; Johannes Maderspacher, Centre for Urban Ecology a

Adaptation via urban green infrastructure (UGI) can significantly reduce the UHI effect and stormwater runoff while contributing to climate change mitigation by reducing cooling energy demands and enhance biodiversity. Still these different goals are rarely considered together. The Centre for Urban Nature and Climate Change Adaptation, funded by the Bavarian Ministry of the Environment and Consumer Protection, seeks to address these challenges in an inter- and transdisciplinary approach. The benefits of UGI scenarios for outdoor as well as indoor thermal comfort and buildings' energy demand were assessed by coupling microclimate modelling (EnviMet) with thermal building simulation (IDA-ICE). The methodological approach has been tested at neighbourhood level for an urban block in Munich, Germany, representing a typical urban fabric with a high degree of compactness and surface sealing. Results showed the varying effectiveness of UGI measures (e.g. street tree plantings, greening of courtyards, green roofs and facades) in reducing the potential for indoor overheating during hot summer days. The impact of GI on cooling measures at building level (e.g. cross ventilation, chiller) will be shown. Potentials and limitations for enhancing biodiversity under the different UGI scenarios were explored based on field data and a literature review.

Changes in connectivity among southern Great Plains wetlands over the past 30 years as a function of land-use change

Nancy E. McIntyre, Texas Tech University; Steven D. Collins, Straughan Environmental Inc.; Lucas J. Heintzman, Texas Tech University; Rebecca R. Owens, Texas Tech University; Niki N. Parikh, Texas Tech University; Luis J. Ruiz, Texas Tech University; Sco*

The ephemeral freshwater wetlands of the southern Great Plains (playas) form a unique ecological habitat network for wildlife. We used satellite imagery to examine effects of land conversion on the occurrence of >8000 playas over three decades (1980's-2000's) in a ~34,000 km^2 portion of Texas that has the highest density of playas in the world. Relative to historic locations of playa basins based on hydric soils, playas that no longer held water even during regionally wet times were usually surrounded by tillage agriculture; those associated with urban development, however, had prolonged hydroperiods even during drought. We used principles and practices from graph theory to determine effects of playa losses from land use/land cover change on the network's topology and thus on connectivity. Network topology has thinned over the past three decades from drought and land conversion, resulting in a ~70% loss of playas in terms of capacity to hold water, but surprisingly, average coalescence distance has not increased. This indicates a loss of path redundancy through the network. The status of any given playa as a stepping-stone, cutpoint, or hub for maintaining connectivity was dynamic, depending on precipitation and land use, thus affecting network topology and connectivity.

Breaking the modeling communication gaps: models talking with ecologists, the data, and each other.

Michael Dietze, Boston University; Elizabeth Cowdery, Boston University; Ankur R. Desai, University of Wisconsin; Brady Hardiman, Boston University; Ryan Kelly, Boston University; Rob Kooper, National Center for Supercomputing Applications; David LeBauer*

Models play a critical role in synthesizing our understanding of ecosystems and making forward projections into novel conditions. Increasingly, models are being used as a scaffold for data-driven synthesis and are central to ecological forecasting. However, models remain inaccessible to most ecologists, in large part due to the informatics challenges of managing the flows of information in and out of such models. Managing the communication between models and data involves three distinct challenges: dealing with the volume of Big Data; processing unstructured and uncurated 'long tail' data; and the need to capture a range of uncertainties in model-data comparisons and formal data-model

assimilation. Finally, model development has long been an academic cottage industry, with different models lacking compatible formats for inputs, outputs, and settings. This has lead to massive redundancies and minimal reproducibility. As a result, the pace of model improvement has been glacial. PEcAn (pecanproject.org), a model-data ecoinformatics toolbox, tackles many of these communication gaps. Users interact will models through intuitive web-based Google-Map-based interfaces, a single API, and standardized file formats. Standardization allows the development of common, reusable tools for processing inputs, visualizing outputs, and automating analyses. PEcAn includes state-of-the-art Hierarchical Bayes tools for model parameterization, data assimilation, and uncertainty analysis, and leverages Brown Dog tools for processing uncurated data. A PostGIS database tracks all inputs, outputs, and model runs, greatly increasing reproducibility and reliability. Finally, database syncs and file sharing across PEcAn allows the community to effectively analyze many models distributed across a global network.

Assessment of environmental controls on forest burn severity in Heilongjiang province, China

Yu Chang, State Key Laboratory of Forest and Soil Ecology, Institute of Applied Ecology, Chinese Academy of Sciences;Dan Shen, State Key Laboratory of Forest and Soil Ecology, Institute of Applied Ecology, Chinese Academy of Sciences; Zhiliang Zhu, U.S.

Quantitative assessment of forest burn severity is important for forest fire management and accurate estimate of carbon emissions by forest fires. Remote sensing has become the common approach for this type assessment. In this paper, we assessed forest burn severity based on pre- and post-fire Landsat TM/ETM+ data and field surveyed data, and explored environmental controls on forest burn severity patterns. Our results showed a relatively strong linear relationship between normalized burn ratio (NBR) and composite burn index (CBI) (R2 = 0.63); The forest burn severity showed heterogeneous patterns and the majority of heavily burned areas were distributed within elevation greater than 800 meters, with slope between 5ï‚° and 15ï‚°, with eastern and southern slopes and in conifers; Elevation, slope, aspect and daily mean humidity had determinative influence on forest burn severities. The forest burn severity demonstrated a north to south gradient. The Great Xing'an Mountains located in the north of Heilongjiang province tended to be burned with high severity while the Small Xing'an Mountains located in the central part with lower severity.

The Impact of the Change in Vegetation Structure on the Ecological Functions of Salt Marshes: The Example of the Yangtze Estuary

Xiuzhen Li, East China Normal University; Linjing Ren, East China Normal University; Yu Liu, East China Normal University*

Salt marshes worldwide are faced with threats from rising sea levels and coastal development. We measured changes in saltmarsh vegetation structure using remote sensing and its consequences for carbon sequestration, wave attenuation, and sediment trapping ability using remotely sensed imaging, field measurement data and published literature data pertaining to the Yangtze Estuary, a rapidly urbanizing area in Eastern China. From 1980 to 2010, the total area of vegetated saltmarsh decreased by 17%, but the vegetation structure changed more dramatically, with the ratio of Phragmites:Spartina:Scirpus changing from 24:0:76, to 77:0:23, 44:13:43 and 33:39:28 in 1980, 1990, 2000 and 2010 respectively. Carbon sequestration increased slightly from 1980 to 2010, with the dramatic shifts in plant species composition. The total length of seawall inadequately protected by salt marsh vegetation increased from 44 km in 1980 to 300 km in 2010. Sediment trapping ability increased (from 8 to 14 million m3/yr) due to the spread of Spartina, which to some extent compensated the loss of total vegetated area in the salt marsh. Changes in the delivery of functions were not linearly related

to the change in the area of vegetated saltmarsh, but more from the combined effect of changing vegetation structure, sediment input and land reclamation. Under threat of sea level rise, protection and maintenance of vegetation structure outside the sea wall is of great importance for the healthy development of the coastal zone.

Reconstructing an Old-Growth Cypress Forest from Legacy Effects of Historic Logging

Kimberly Meitzen, Texas State University

Historic logging resulted in the removal of significant amounts of old-growth cypress (Taxodium distichum) from bottomland hardwood floodplain forests from Texas to Virginia. Old-growth cypress are important to the ecosystem for a variety of benefits and their removal affects numerous biological and physical ecosystem processes. This research quantifies the density of logged old-growth cypress from the Congaree River floodplain in Congaree National Park, South Carolina; a landscape that was heavily targeted for selective removal of this species but is now protected from future logging impacts. Cypress stand recovery has been limited and there is a need to better understand the extent and intensity of historic logging on this forest landscape. Legacy evidence of the cypress were surveyed for 41 sites distributed across 6 distinct areas of the floodplain. Stumps and pits were categorized into 9 classes which varied relative to size and type of remnant stump. GPS points were collected for stumps with basal areas greater than two meters and decomposition was qualitatively assessed to describe potential for future dendrochronology analysis of these large specimens. Data was collected for > 2,000 cypress stumps. All field-collected data and calculated metrics were incorporated into a GIS to virtually reconstruct the pre-logged old-growth cypress forests for the surveyed sites. This study will provide a baseline for comparing current and historic forest communities and inferring long-term changes in biodiversity, floodplain-wood dynamics, carbon storage, and geomorphic processes.

Latest advancements of LANDIS-II

Melissa S. Lucash, Portland State University; Robert M. Scheller, Portland State University; Eric J. Gustafson, U.S. Forest Service Northern Research Station*

The LANDIS-II model is widely used to investigate forest change as a result of climate change, disturbances, and management. Over the past few years, there have been significant changes in the development of the LANDIS-II model. This introductory talk will describe the modifications to the LANDIS-II/Century extension, which fully integrate climate with succession and disturbances like wind, insects, drought, and wildfire. We will also demonstrate the use of the new visualization tool that allows managers and researchers to quickly display the spatially-explicit model projections of LANDIS-II (without ArcMap), and compare different harvesting and disturbance scenarios under climate change. Finally, we will describe efforts underway to integrate models (e.g. LANDIS-II and LANDIS-PRO) and use the Century and PnET Succession extensions of LANDIS-II to inform regional management planning efforts in the U.S.

Green infrastructure strategies for climate change in urban areas

Stephan Pauleit, Teresa Zolch, Johannes Maderspacher, Werner Lang - TU Munchen, Centre for Urban Ecology and Climate Adaptation, Munich, Germany

Urban green infrastructure (UGI) offers various benefits for climate change adaptation, notably by reducing the urban heat island effect and stormwater runoff, increase of thermal comfort for outdoor recreation and promotion of biodiversity; for climate change mitigation by reducing cooling energy demands and carbon sequestration. Still these different goals are rarely considered together in urban

planning. The Centre for Urban Ecology and Climate Adaptation, funded by the Bavarian Ministry of the Environment and Consumer Protection, seeks to address these challenges in an inter- and transdisciplinary approach with partners from two Bavarian cities, Munich and Wurzburg. The project aims to develop integrated strategies for climate change mitigation and adaptation which are supported by evidence from rigorous scientific study. The benefits of UGI scenarios for outdoor as well as indoor thermal comfort and buildings' energy demand are assessed by coupling microclimate modelling with thermal building simulation. The methodological approach is tested at neighbourhood level for exemplars of urban fabric types representative for larger Bavarian cities. Results show the varying effectiveness of UGI measures (e.g. street tree plantings, greening of courtyards, green roofs and facades) in reducing thermal loads in open spaces and indoor overheating during hot summer days as well as stormwater runoff. Furthermore, potentials and limitations for enhancing biodiversity under the different UGI scenarios are explored. The paper will present the conceptual framework for this research and discuss the synergies and trade-offs for climate change mitigation and adaptation of different UGI strategies.

Landscape assessment of habitat loss: a new approach for a global biodiversity hotspot

Jennifer K. Costanza, North Carolina State University; William J. Platt, Louisiana State University; Reed F. Noss, University of Central Florida*

Identifying conservation priorities for global biodiversity and endemism hotspots involves characterizing threats to habitats. Threat assessment is often based on the extent of loss of natural vegetation. Although land cover data provide quantitative information on the degree of conversion to anthropogenic land uses, they usually provide little information about the condition and structure of existing vegetation. Assessing the condition of remaining vegetation across large spatial extents such as landscapes is difficult. For example, in landscapes with historically fire-dependent vegetation, shifts from a high proportion of open savanna-like habitat, to a current denser, forest-like vegetation due to fire suppression are often major ecological threats and thus important to characterize. We developed an approach to assess habitat modification in the newest global biodiversity hotspot, the North American Coastal Plain (NACP), which contains a large proportion of fire-dependent vegetation. The approach incorporates landscape data on vegetation structure for individual ecosystems, along with recent fire occurrences, to calculate landscape-level shifts in vegetation structure. We found that the vegetation in the NACP is highly modified: 85% of the NACP, and 96% of the most fire-dependent ecosystems in the region have been modified from historic conditions. Furthermore, we show that within the NACP, the regions and vegetation types most highly modified are those with the high levels of richness and endemism that make the region a biodiversity hotspot. Our approach to assessing vegetation modification reveals new patterns and relationships with species diversity in the NACP, thus providing critical information for conservation in this global biodiversity hotspot.

Perspectives on European Urban Green Infrastructure Planning: a comparative analysis of 20 cities

Rieke Hansen, Technische Universitat Munchenh; Emily L. Rall, Technische Universitat Munchen; Stephan Pauleit, Technische Universitat Munchen*

"GREEN SURGE", a collaborative research project funded by the European Union, aims to further develop urban green infrastructure (UGI) as a strategic planning approach to deliver a wide range of ecosystem services in European cities. The project adopts a three-tiered approach for i) comparative analysis of 20 European cases, ii) synthesis of good practices, and iii) strategy development in five Urban Learning Labs. In the first tier we analyzed the current state of UGI planning and implementation based on a multi-method approach including interviews, literature review, and document analysis. Planners

from the selected 20 case study cities largely expressed a shared understanding of principles and themes related to UGI planning. However, the term has only explicitly been applied in cities from the UK and Barcelona. The majority of the cities consider connectivity and multifunctionality as important principles, while planning on multiple spatial scales and integration of green space with other infrastructures offer potential for enhancement. We further uncovered interest for stronger collaboration with scientists and the business community. Our study revealed a variety of approaches for strategic green space planning in Europe and potentially innovative approaches to be further analyzed and developed in the course of the research project.

Informal Settlement Intervention: How Does It Impact Urban Ecosystem Services and Disservices?

Olumuyiwa Adegun, University of the Witwatersrand*

This presentation considers ecosystem services and disservices from green infrastructure in informal low-income urban settlements - a significant mode of urban shelter in developing countries. It reports a study that utilises qualitative methods, semi-structured interviews, focus group, transect walk, community engagement in two areas of Johannesburg, South Africa. Ruimsig informal settlement, the first area is located by a wetland and is presently undergoing in situ upgrading. Cosmo City, the second area, sits on an environmentally sensitive land and embodies relocation and township establishment for an informal settlement. I found out that the two intervention approaches reduces ecosystem services derived by residents located in informal settlements. It cannot be ascertained if the two approaches, as it were, both reduces or increases ecosystem disservices. The study highlights the importance of considering green infrastructure that produce these ecosystem services for informal settlement residents as part of overall urban environmental sustainability.

Determinants of species richness for multiple species groups in urban green spaces

Stefan Ruter, Institute of Environmental Planning; Sarah A. Matthies, Institute of Environmental Planning; Frank Schaarschmidt, Institute of Biostatistics, Leibniz University Hannover*

It is widely recognized that green spaces provide habitat for numerous plants and animals. However, currently we have little knowledge of which determinants drive the species richness across multiple species groups. The objective of this paper is to analyze the determinants of total, native, and endangered species richness for mammals, birds, and vascular plants. We examined a stratified random sample of 32 green spaces in Hannover, Germany. Species lists for birds and plants were generated based on line transect surveys in 2011/2012. Mammals were surveyed by point counts using camera traps in 2012/2013. Applying PCA and sequential F-tests, we tested the effects of 10 predictor variables that describe patch metrics, habitat heterogeneity, and connectivity of green spaces. The species numbers of all groups were significantly positively correlated to patch size. The total number of mammals and native plant species also showed positive correlations with the connectivity of green spaces. Testing combined effects of variables indicated that patch size in combination with habitat heterogeneity was the most important predictor for birds, plants, and overall species richness. We conclude that, in the context of urban ecological planning, it is important to conserve large green spaces that include a diversity of habitats.

Urban sprawl without growth - how demographic shrinkage changes land use patterns and infrastructure efficiencies

Stefan Siedentop, Research Institute for Regional and Urban Development, Dortmund/Germany

Previous research on the drivers, patterns and impacts of urban sprawl has always been conducted from a perspective of growth. However, more and more European regions are faced with population decline, a process resulting, in the long run, in decreasing land demand, large stocks of Brownfield land and under-utilized urban services. Although the effects of demographic changes on urban and regional development have been subject of intensive research activities not much is known about how demographic shrinkage changes urban land use patterns and the performance of infrastructure systems. This presentation is based on the argument that urban sprawl, its main physical features, and its impacts on infrastructure are not merely a by-product of urban growth. Building on earlier studies that differentiate between types of urban sprawl, sprawl-like development paths in cities facing demographic change will be identified. Based on a conceptual model of land use change patterns in shrinking cities the presentation will focus on the specific relationships between demographic changes, urban form manifestations and infrastructure performances. Recent experience in Germany demonstrates that the decrease of population densities and the ongoing "perforation" of urban land uses (in form of under-utilized, vacant and Brownfield land) are strongly linked with cost inflations due to system's underutilization. The presentation begins with a brief discussion of the complex drivers of the "sprawl without growth" phenomenon as well as its urban form manifestations. The second part summarizes the empirical findings of recent cost-of-sprawl studies with a perspective on both growing and shrinking populations.

Matrix intensification affects body and physiological condition of tropical forest-dependent passerines

Justus P. Deikumah ,Department of Entomology and Wildlife;Clive A. McAlpine;Martine Maron, The University of Queensland, Landscape Ecology and Conservation Group, School of Geography, Planning and Environmental Management*

Matrix land-use intensification is a relatively recent and novel landscape change that can have important influences on the biota within adjacent remnant habitats. While there are immediate local changes that it brings about, the influences on individual animals occupying adjacent habitats may be less evident initially. Anthropogenically-mediated chronic stress from the effects of high-intensity land use could affect individuals in nearby remnants, leading ultimately to population declines. We investigated how physiological indicators and body condition measures of tropical forest-dependent birds differ between native remnants adjacent to surface mining sites and those near farmlands at two distances from remnant edge in southwest Ghana. We used mixed effects models of several condition indices including residual body mass and heterophil to lymphocyte (H/L) ratios (an indicator of elevated chronic stress) to explore the effect of landscape change and matrix intensification on two contrasting categories of tropical forest-dependent passerines (sedentary area-sensitive habitat specialists vs. nomadic highly mobile generalists). Individual birds occupying tropical forest remnants near surface mining sites were in poorer condition, as indicated by lower residual body mass and elevated chronic stress, compared to those in remnants near agricultural lands. The condition of the sedentary forest habitat specialists Alethe diademata and Cyanomitra obscura was most negatively affected by high-intensity surface mining land-use adjacent to remnants, whereas generalist species were not affected. The carrying capacity of a landscape is likely to be affected not only by habitat extent, but also by the hospitability of the matrix, which is in turn influenced by intensity of land use. Land use intensification may set in train a new trajectory of faunal relaxation beyond that expected based on habitat loss alone. Patterns of individual condition may be useful in identifying habitats where species population declines may occur before faunal relaxation has concluded.

Vulnerability of Hawaiian Tree Snails to Climate Change and the Genetic Potential for Adaptation

Dr. Melissa R. Price, Department of Natural Resources and Environmental Management; Dr. Zac Forsman, Hawaii Institute of Marine Biology; Dr. Robert J. Toonen, Hawaii Institute of Marine Biology; and Dr. Michael G. Hadfield - University of Hawai'i at MÄ□n*

The federally listed, endemic Hawaiian Tree Snails (Achatinellinae) have been rapidly disappearing due to introduced predators and habitat disturbance, and only remain in fragmented refugia. All populations are at the highest elevations available (550 - 1220 m) over steep precipitation gradients (1100 - 1900 mm annually) and will likely be impacted by climate change as native habitats become warmer and drier. Using restriction-site associated DNA (RAD) we generated millions of DNA sequences from across the genome of Achatinella mustelina, the only remaining species in its genus with a relatively broad geographic range (25 km). By integrating landscape genetics with environmental data and population parameters, we seek to identify gene regions involved in environmental adaptation by correlating single nucleotide polymorphisms (SNPs) with environmental parameters (e.g., temperature and rainfall). These data provide an example of the utility of landscape genetics in determining the spatial distribution and number of management units, biodiversity conservation and management in these critically endangered tree snail species. Alarmingly, our results suggest the remaining tree snail species are extremely low in genetic diversity and highly differentiated among geographically close but fragmented populations over the species range. We see no evidence of connectivity throughout the remaining range, with fixed differences among geographic sites suggesting decreased capacity for adaptation to environmental change. These results may inform decisions to combine populations in ways that will maximize adaptive ability in the face of global climate change by increasing genetic variation within species in gene regions important to heat and drought tolerance.

Practical applications of socio-cultural valuation to spatial planning policy

*Craig Bullock *, Deirdre Joyce, Marcus Collier -University College Dublin, Ireland, School of Architecture, Planning and Environmental Policy*

The concept of ecosystem services supplies a means to demonstrate to decision makers and the public how human society is ultimately dependent on the natural environment. An articulation of socio-cultural values can be demonstrated as they apply to regulating, provisioning and cultural services. Hitherto, much of the valuation of these ecosystem services has been performed using economic methods. However, our interaction with the natural environment is complex and subject to a far wider range of benefits than personal utility alone. The presentation will discuss the merits of alternative socio-cultural valuation using the example of a coastal environment in Ireland. In this application, we are using deliberative approaches and mapping to explore the relationship between socio-cultural values and ecosystem services. The objective is to explore the range of values and their prevalence within the community. We then propose to combine this valuation with economic methods either as a supporting tool or within a complementary process. The intension is that the public authorities will be able to replicate these approaches in participatory planning exercises. In addition, we propose that decision makers will be sufficiently confident of the methods' usefulness to incorporate socio-cultural values within spatial planning decisions and green infrastructure provision.

Climate change, urban environment and landscape metabolism: simulation studies in arid clmates.

Massimo Palme, School of Architecture, Catholic University of the North, Antofagasta, Chile

In the last years, metabolic approach to urban and rural dynamics was increasing its impact on different practices and theories: from city planning to urban pollution models, many disciplines start using flow

concepts coming from ecology and thermodynamics. This paper focuses on required energy inputs and emissions outputs generated by buildings operation in arid climates, under different climate change scenarios. Global warming prediction for arid regions of the world is especially extreme: up to 6 degrees Celsius are expected in northern Chile, for example. This work presents simulation studies for the city of Antofagasta, located in the Atacama Desert and facing the Pacific Ocean. Urban development of the city (vertical growth combined with extreme longitudinal sprawl) is affecting the microclimate, generating heat island effect and blockage of breezes that are necessary to cool the city in hot periods of the year. Simulation studies consider predictions of the Intergovernmental Panel for Climate Change for Antofagasta location and different urban growth projections to estimate future heating and cooling loads for buildings. Comfort in the public environment is also discussed with reference to actions that are needed to adapt the city and at the same time to mitigate the built environment effect on global warming.

Developing a sustainability indicator set for measuring green infrastructure performance

Parisa Pakzad, Ph.D. candidate, Sustainable urbanism; Dr. Paul Osmond, Senior Lecturer - University of New South Wales, Australia

The ability to assess the sustainability performance of the built and natural environments based on measurable criteria at a variety of temporal and spatial scales is critical for sustainable urban development. In recent years, integrated networks of green spaces at city scale, or "green infrastructure", are seen increasingly as fundamental to the delivery of ecosystem services for human and environmental health. A range of models that assess the performance of specific aspects and elements related to green infrastructure have been developed in response. However, there is no consensus on a model that is comprehensive and integrative across all types and aspects of green infrastructure and ecosystem services. This paper presents a conceptual framework to facilitate the development of an inclusive model for the sustainability assessment of green infrastructure. The framework focuses on key interactions between human health, ecosystem services and ecosystem health. This study reviews existing models, including sustainability indicator selection criteria and the indicators themselves, explores their weaknesses and strengths and highlights relevant gaps in their assessment methodologies. This analysis, combined with input from built environment industry stakeholders, enables derivation of a conceptual framework that identifies and brings together the criteria and key indicators. This integrated framework may then be applied to develop a composite indicator-based assessment model to measure and monitor performance of green infrastructure projects and support future studies.

Identifying the relationships between ecosystem services across scales: a case study in the Northern Agri-pastoral transition zone, China

Ruifang Hao, State Key Laboratory of Earth Surface Processes and Resource Ecology/ Center for Human-Environment System Sustainability (CHESS), Beijing Normal University

Understanding the tradeoffs of Ecosystem service (ES) is important in the human sustainability science. The ESs relationship across scales can help understand the ES tradeoffs. In the Northern Agri-pastoral transition zone, the six classes of ES, including Net primary productivity (NPP), nutrient cycling, water yield, water retention, soil wind erosion control, and soil water erosion control, were respectively modeled by the Carnegie-Ames-Stanford Approach (CASA) model, nutrient distribution, the InVEST model, the Revised Wind Erosion Equation, and the Universal Soil loss Equation in 2000 and 2010. The relationships between the pair-wise ESs were represented by the fitting of a polynomial. We changed the analysis grain and the fitting space to find the law of the relationships. The relationship between

NPP and water yield was unstable and it was greatly influenced by the rainfall. On the contrary, the relationship between NPP and soil water erosion control was stable and they showed positive relationship in different fitting spaces and different grains. Water yield and soil water erosion control had no obvious relationship. NPP and nutrient cycling were positive correlation. Water yield and soil water erosion control were both positive correlation with soil wind erosion control. Therefore, the relationships between ecosystem services are not constant across scales.

Quantification of ecosystem services in the Upper Santa Cruz Watershed, Arizona, USA

Kremena Boyanova, Bulgarian Academy of Sciences, National Institute of Geodesy, Geophysics and Geography, Sofia, Bulgaria; Rewati Niraula, University of Arizona, Department of Hydrology and Water Resources, Tucson, AZ; Zhao Yang, University of Arizona, D*

The presented research is part of the European Union (EU) funded SWAN project - Sustainable Water ActioN: Building Research Links between EU and US. The project is building a transatlantic dialogue responding to the need for interdisciplinary collaboration on water issues. Researchers from the USA and five EU member states (Bulgaria, France, Netherlands, Spain, United Kingdom) join efforts within their disciplines to address the water stress situation in the Southwestern US. Focusing on the Upper Santa Cruz watershed, located mainly in southern Arizona and a smaller part in northern Mexico, the research aims to understand the water-related ecosystem services through the analysis of the hydrological cycle within the case study area. For that purpose, outputs from the hydrological model SWAT were used. This provided essential understanding of the impacts of ecosystems' state on the ecosystem services flows to the society. Moreover, possible impacts of climate change and urban growth scenarios can be assessed. Understanding the hydrological cycle within the Upper Santa Cruz watershed is also important for recognizing the drivers of decisions taken in this area, like groundwater recharge from the Central Arizona Project (CAP), which has been the main water supplier in the area for many years, allocating the water of the Colorado River. A comparison between natural and CAP groundwater recharge provides significant insights into the processes in the watershed - natural as well social. Riparian vegetation, as key service provider in a semi-arid area, is also dependent on the hydrological cycle and is a main indicator of ecosystem health.

Dealing with highly fuzzy landscapes: how to assess High Nature Value Farmland in Mediterranean silvo-pastoral systems

Teresa Pinto-Correia, Sergio Godinho, Nuno Guiomar, Carla Azedo, Carlos Guerra ICAAM, UNiversity of Ã‰vora, Portugal*

High Nature Value Farmland (HNVF) is a classification scheme aimed to integrate biodiversity conservation and environmental concerns in the European agriculture. It intends to identify low intensity farming areas that supports high species and habitat diversity and/or the presence of priority species for conservation at European, national and regional level. The implementation of the HNVF concept across Europe by each country is a changeling process not only due to the lack of adequate datasets (detailed biodiversity databases, land cover maps, etc.) but mainly due to the diversity of rural landscapes across Europe. Nevertheless, maps with precise boundaries are requested in for policy formulation and implementation. Some of the largest HNVF areas in Europe are found in southern Europe. The agro-silvo-pastoral system dominated by cork oak and/or holm oak in varying densitie is broadly classiï¬ed as HNVF. However, because it presents a degree of spatial fuzziness determined by the variability in tree cover and shrub density, biodiversity values also vary between montado types. This presentation intends a) to demonstrate and discuss drawbacks in implementing the HNVF concept in fuzzy landscapes such as the montado, and b) to suggest and demonstrate approaches to improve the

effectiveness and accuracy in HNVF classifications in this kind of farmland landscapes, and c) to discuss how landscape ecology approaches best can inform policy making, in the context of highly fuzzy landscapes.

Evaluating species diversity under climate change: Environmental DNA analysis in a semi-arid wetland ecosystem

Charlotte Gabrielsen, Department of Ecosystem Science and Management, University of Wyoming; Melanie Murphy, Department of Ecosystem Science and Management, University of Wyoming; Jeffrey Evans, Central Science/Conservation Lands, The Nature Conservancy*

Wetlands are a critical component in semi-arid regions where water availability is a major concern. Wetlands support ecosystem services, including breeding and dispersal habitat. However, climate change, a major landscape stressor, is predicted to substantially alter ecosystem characteristics. To characterize potential effects of climate change to wetland-dependent species, we conducted biodiversity assessments using environmental DNA (eDNA) survey techniques, which permit molecular detection of a wide range of taxa in ponds, lakes, and streams. Our study employed water samples collected from 353 wetlands throughout the U.S. Northern Great Plains and field measurements of wetland location, depth, size, soils, vegetation, and water quality. We developed species-specific mtDNA PCR tests designed to identify the presence of selected microbial (Escherichia coli) and amphibian (northern leopard frog, boreal chorus frog, tiger salamander) species. Using these resources, we employed quantitative PCR to determine relative microbe and amphibian abundances and obtained a measure of biodiversity (Shannon's Diversity Index) at each wetland. We related biodiversity metrics to current habitat and landscape features. We also used predictive models to project biodiversity under a range of potential climatic conditions reflecting changes to temperature, and precipitation amount and timing. Overall, we found highest species diversity in ephemeral wetlands, and lower diversity in both highly ephemeral wetlands and permanent wetlands. Additionally, we observed a shift to more highly ephemeral wetlands under climate change. This resulted in lower species diversity across a higher proportion of wetlands in the region. By evaluating contributions of ephemeral wetlands in semi-arid ecosystems to biodiversity, our research provides a foundation from which to examine potential future alteration of these metrics under climate change. It also facilitates future evaluation of how changes to biodiversity under climate change may affect genetic connectivity among amphibians and other wetland-dependent species.

A new generalized network model of habitat connectivity accounting for the number of dispersing individuals

Marie-Josee Fortin, Department of Ecology and Evolutionary Biology, University of Toronto, Canada; Santiago Saura, Departamento de Sistemas y Recursos Naturales, Universidad Politecnica de Madrid, Spain; Orjan Bodin, Stockholm Resilience Centre, Stockhol*

Climate and land-use changes will require species to move large distances following shifts in their suitable habitats, which will frequently involve traversing intensively human-modified landscapes. Practitioners will therefore need to evaluate and act to enhance the degree to which habitat patches scattered throughout the landscape may function as stepping stones facilitating dispersal among otherwise isolated habitat areas. We formulate a new generalized network model of habitat connectivity that accounts for the number of dispersing individuals and for long-distance dispersal processes across generations. We find that the loss of intermediate and sufficiently large stepping-stone habitat patches can cause a sharp decline in the distance that can be traversed by species (critical spatial thresholds) that cannot be effectively compensated by other factors previously regarded as crucial for

long-distance dispersal (fat-tailed dispersal kernels, source population size). We corroborate our findings by showing that our model largely outperforms existent connectivity models in explaining the large-scale range expansion of a forest bird species, the Black Woodpecker (Dryocopus martius), over a 20-year period. Findings from our new generalized network model stress that stepping stones must be of sufficient size to be of conservation value and are particularly crucial for the spread of species over long distances.

Mine reclamation schematic design based on ecosystem services and landscape ecologyï¼šA case study in Liaoning province, China

Jiali Wang, University Chinese Academy of Sciences; Jian Yang, Insistute of Applied Ecology, Chinese Academy of Sciences; Fuqiang Zhao, Insistute of Applied Ecology, Chinese Academy of Sciences; Shengwei Jiang, Mountain Protection Bureau of Liaonin*

Mining exploitation is one of the strongest activities of human disturbance, which often lead to irreversible damage to ecotope. It is necessary for mining companies and government to take appropriate measures to restore the damaged environment after the mine closure. Although the importance of spatial neighborhood has long been recognized for restoring mine extraction sites, reclamation schemes tend to select the restoration targets and implementation methods based on the inherent site conditions alone. Neither landscape-scale ecological integrity nor the demands of human society have been adequately considered. This study is set to explore various reclamation alternatives at landscape scales with a special attention to the interaction of spatial patterns and ecological, social, and economical processes. We chose about 30 representative mining sites across three major regions in Liaoning province, China with varied economical development levels and environmental conditions. We evaluated the differences in ecosystem services provided by mine reclamation under three scenarios: economic benefits maximization, site-scale ecological restoration, and landscape integrity conservation. We show that site-scale natural restoration provides a more diverse array of ecosystem services than would be delivered under economic benefits maximization scenario. Furthermore, our study demonstrates an enhanced ecosystem service provision under the landscape integrity conservation scenario, due to the improved landscape connectivity and habitat diversity. This work provides an exemplary case study highlighting how the integration of landscape ecology with ecosystem services could be used to restore industrial wastelands in an era during which natural resources are being intensively extracted and transformed.

Exploring the Ability of Optical and Sar Imagery Detecting Small Dimension Habitats in a Flood Plain Landscape

Julia Arieira, Universidade de Cuiaba (UNIC) / INAU; Catia Nunes da Cunha, Instituto Nacional de Ciencia e Tecnologia em Ã reas Ãšmidas (INAU)*

Monitoring and description of wetlands are assisted by remote sensing imagery because of its ability to detect temporal variation in spatial patterns over large areas. This study evaluated the ability of optical and SAR images to detect wetland habitats in a Brazilian floodplain landscape. Remote sensing images were dated during periods of low and high waters, providing spectral response under different flood conditions. Supervised classification was applied to Landsat-TM and SPOT images using maximum likelihood algorithm resulting in an classification accuracy of 79.2%. The classification of polarimetric ALOS-Palsar images was performed using two algorithms: Maxima likelihood (MaxVer) and Iterated Conditional Modes (ICM) applied to multivariate data in amplitude. The mots accurate classification was achieved using ALOS Palsar images of low and high waters in both HH / HV with the polarimetric classifier ICM (82.4%). The differential response in backscattering coefficient of habitats over the

hydrological months helped in habitat discrimination. Summed to its higher accuracy, the ALOS-palsar mapping approach provides a higher resolution information, suggesting its greater efficiency in mapping small dimension habitats subjected to seasonal flooding.

Trajectories of forest landscape change following an abrupt shift in public policy and management practices (Atlantic Northern Forest, U.S.A.)

Kasey R. Legaard, University of Maine; Steven A. Sader, University of Maine; Erin M. Simons-Legaard, University of Maine*

Sustainable management of forested landscapes requires knowledge of functional relationships between management actions, landscape conditions, and forest values. Changes in management practices make it fundamentally more difficult to study these relationships because the impacts of current practices are intertwined with the persistent influences of past practices. Within the Atlantic Northern Forest of Maine, U.S.A., forest policy and management practices changed abruptly in the early 1990s following a severe insect outbreak and widespread salvage clearcutting of vulnerable forest. Clearcut regulation resulted in an abrupt shift to near complete dependence on partial harvesting. We assessed cumulative landscape change caused by these two very different management regimes using a time series of Landsat imagery (1973-2010). We modeled temporal patterns of harvesting using an empirical orthogonal function analysis, and segmented a large study area into groups of landscape units with similar management histories. Time series of composition and configuration metrics revealed differences in landscape dynamics between groups. In some, salvage logging caused rapid loss and subdivision of intact mature forest and created persistent legacies in the form of large blocks of regenerating forest and conversion of spruce-fir to other forest types. In other groups, contemporary partial harvest practices caused loss and subdivision of intact mature forest at even greater rates, and the rapid accumulation of large numbers of small regenerating forest patches with a correspondingly large amount of edge. Different management regimes affected different segments of the study area to different degrees, resulting in distinct temporal trajectories of landscape change.

Participatory landscape character assessment (LCA) for land use planning and forest management in Zanzibar, Tanzania

Authors: Niina Kayhko1, Nora Fagerholm1, Miza Khamis2, Sheha I. Hamdan2, Muhammad J. Muhammad3. 1 University of Turku, Department of Geography and Geology, Turku, Finland. 2 Department of Forestry and Non-Renewable Natural Resources, Government of Zanziba

Zanzibar (Unguja) character map describes the current landscape of the island as a synthesis of land cover, land use and physical landforms combined with prevailing land use and forest management practices, socio-economic conditions and historical and anticipated future land dynamics and changes. The character map was created in 2012-14 through in interactive dialogue between technical professional work, stakeholder involvement and participatory validation. The process was aiming to be a policy supportive instrument for the government and other stakeholders to discuss, argue and finally make decisions on land and forest management and directions of development. The LCA process involved expert knowledge from the regional and local stakeholders and tackled, for example, with the descriptions of the landscape types and assignment of geographical names for each landscape character area. The approach was completely new type of approach for Zanzibar stakeholders to work with. In this presentation, we will discuss how the landscape character mapping and assessment proceeded as a supportive process in spatial land and forest planning, and how it was perceived by the key actors involved. We look into the knowledge building and sharing processes during the mapping and reflect on the roles and values of different stakeholders in consecutive stages of the characterisation process. Our

presentation also discusses the methodological issues, especially participatory related aspects in the identification process of the landscape character areas. We conclude by laying out a suggestion how the role and of stakeholder participation in different stages of the characterisation process can be formulized and executed and what elements of the process may promote sustainable land use planning and management in Zanzibar and other equivalent geographical areas.

Impact of human-provided food resources on infectious disease dynamics

Daniel Becker, Odum School of Ecology, University of Georgia; Richard Hall, Odum School of Ecology & College of Veterinary Medicine, University of Georgia Daniel Streicker, Institute of Biodiversity, Animal Health, and Comparative Medicine, University*

Landscape changes such as urbanization and agriculture cause declines in many wildlife populations, but some species benefit from novel food resources available in human-dominated habitats. Resulting shifts in wildlife ecology from food provided through bird feeders, landfills, and crops can alter infectious disease dynamics within maintenance hosts and create opportunities for cross-species transmission, yet predicting host-pathogen responses to resource provisioning is challenging. Factors enhancing transmission, such as increased host aggregation, could be offset by better immune defense due to improved nutrition. This talk provides a conceptual framework to address how human-provided food interacts with infectious disease risk and identifies key mechanisms by which this occurs. Our recent meta-analysis characterizes the wide heterogeneity in infection outcomes of provisioning, which are in turn associated with pathogen type and the source of anthropogenic food. Furthermore, novel mathematical model explorations show how interactions between opposing mechanisms can lead to strong nonlinear-and often counterintuitive-effects of human-provided food on pathogen invasion and spatial spread. The landscape management implications of these findings are discussed within the context of livestock rearing in the Amazon and the consequences for the ecology of vampire bat-pathogen interactions.

Ecosystem services in cultural landscapes

Nynke Schulp, Koen Tieskens, Peter Verburg; VU University Amsterdam*

Cultural landscapes are essential for providing people with ecosystem services, because the management that shaped these landscapes often aimed at ensuring provision of ecosystem services and public goods. This management history is assumed to ensure a flow of ecosystem services from provisioning areas to beneficiares. In different types of cultural landscapes, the goal of landscape management currently differs and has always differed in the past. For example, large-scape arable landscapes aimed at high food production for local supply as well as trade, while hunting grounds target at a more local supply and multifunctional landscapes have emerged from a demand for multiple goods in the same region. Due to these different past landscape management aims, it could be expected that different cultural landscape types can be characterized by distinct bundles of ecosystem service supply and demand. We explored the provision of ecosystem services from cultural landscapes across the European Union. High-resolution maps of the current supply and demand of a wide range of ecosystem services and public goods were created, and summarized into maps of bundles of demand and supply of these ecosystem services and public goods using a variety of expert based and statistical methods. Next, the maps of ecosystem service or public good bundles were compared with a typology of cultural landscapes. The observed distinct bundles of ecosystem services and public goods that characterize cultural landscapes across the European Union can help guiding future management strategies for cultural landscapes.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Spatially explicit modelling and gameification of ecosystem services

Robert Costanza Chair in Public Policy, Crawford School of Public Policy, Australian National University, Canberra Australia,*

Ecosystems are connected to human well-being in a number of complex ways at multiple time and space scales. The challenge of ecosystem services science (ESS) is understanding and modeling these connections, with a range of purposes including raising awareness and providing information to decision-makers to allow them to better manage our natural capital assets. In order for ecosystem services to occur, natural capital must be combined with built, human and social capital. Thus ESS is inherently an integrated, transdisciplinary science that is concerned with the way these four forms of capital contribute to human well-being and the synergies and trade-offs among them. The process of valuation of ecosystem services is about quantifying and modeling these synergies and trade-offs. It requires a deeper understanding of the spatially explicit interconnections among ecosystem processes and functions, economic production and consumption processes at multiple time and space scales, and human psychology and decision processes. This talk will summarize progress on spatially explicit modeling of regional landscapes and new approaches to integrating these models with sophisticated game interfaces to both inform players about system dynamics and to elicit valuation information based on player choices.

Changing the course of rivers in Asian cities: Linking supply of ecosystems services to human benefits through iterative modeling and design

Adrienne Gret-Regamey and Derek Vollmer*

In many developing world cities, rivers and their floodplains play a major role in providing ecosystem services, particularly in lower-income communities relying more directly on them to meet basic needs. While many ecosystem services can be managed locally, hydrological ecosystem services call for larger scale management as the terrestrial ecosystems securing the provision of the services are usually situated in the catchment area whereas the ecosystem services are mostly supplied downstream. In this contribution, we present an iterative design and hydrological modeling approach to define rehabilitation projects of the Ciliwung river securing the provision of needed hydrological ecosystem services in the kampungs (slums) of Jakarta, Indonesia. The iterative process was conducted at three scales from the entire catchment, to the riparian corridor and finally to different strategic local sites where landscape design scenarios are possible. Computational (parametric) design allowed for the coupling of the landscape designs at the site and corridor scale with hydrodynamic models for rapid design feedback, leading to a choice of final scenarios. Finally, a spatially explicit multi-criteria analysis allowed assisting stakeholders in negotiating the tradeoffs in future land development. The iterative multi-scale approach shows how to integrate multiple scale into planning and design for securing the provision of demanded hydrological ecosystem services in rapidly urbanizing river basins.

Simulating pesticide impacts on horned larks: a study in scaling from fields and flocks to populations and landscapes.

Diana L. Dishman, Integral Consulting Inc.; Nathan H. Schumaker, USEPA; Robert A. Pastorok, Integral Consulting Inc.*

Balancing the potential ecological impacts of anthropogenic stressors with the need to optimize food production, as in the case of agricultural pesticide use, creates enormous practical challenges for regulators. Concerns that compounds are impacting legally protected species are creating a need for regulatory decisions, traditionally based on individual-organism scale responses to exposure in

controlled settings, to now account for population-level endpoints. Similarly, it has become increasingly clear that pesticides and multiple other natural and anthropogenic stressors interact in landscape settings, and that these interactions cannot be assumed to be simply additive. Finally, huge numbers of threatened and endangered plants and animals are potentially being affected, and this is creating a need for assessment tools that are biologically realistic, but also parsimonious and quick to develop and apply. Here, we discuss the design and application of a multi-stressor, spatially-explicit IBM (individual-based model) that can relate changes in disturbance regimes at local scales to population trends at landscape scales. Our target species is the endangered Streaked Horned Lark (Eremophila alpestris strigata), and our study region is Oregon's Willamette Valley, an area dominated by agriculture that also includes a network of natural areas and wildlife refuges. We use the horned lark system to illustrate how pesticide impacts to a wildlife population can be disentangled from other dynamic disturbance regimes, but also discuss how our approach can be generalized to address a range of species-landscape-stressor systems, with the eventual goal of producing population-scale rapid assessment tools.

Understanding ecosystem service tradeoffs from urbanization in the Appalachian Mountains, North Carolina, USA.

Brian R. Pickard, Center for Geospatial Analytics, North Carolina State University; Derek Van Berkel, Center for Geospatial Analytics, North Carolina State University; Ross Meentemeyer, Center for Geospatial Analytics, North Carolina State University.*

Urbanization is likely to be a major driver of change for the delivery of ecosystem services (ES) in the coming decades with various trade-offs. Tradeoffs occur when one ecosystem service is enhanced at the expense of another. Understanding how the spatial configuration of urbanizing areas will impact ecosystem services remains a challenge. Simulations of urbanization can be useful in this regard, providing likely approximations of future urban growth patterns. Studies have shown that increasing urbanization results in ecosystem service tradeoffs that are dependent on the pattern of urbanization. Often, models simulating urbanization do not capture disjointed urban configurations typical of southeastern USA urbanization, which are important for ecosystem process and the delivery of ES. FUTURES (FUTure Urban-Regional Environment Simulation) accurately simulates urban growth patterns typical of urbanization in the US. We couple FUTURES with InVEST to investigate the future provisioning (2006 to 2035) of carbon, nutrient retention and biodiversity conservation at fine spatial resolutions for nineteen counties in North Carolina, USA. Applying a range of urbanization scenarios, from high infill densification to low density sprawl, we highlight tradeoffs among ecosystem services as a result of specific urban configurations. Understanding how patterns of urbanization may impact ES and the tradeoffs among them is critical as the southeastern USA continues to expand. This work demonstrates a framework to identify patterns of urban configuration that may limit impacts to ecosystems.

Lifestyle Causes of Suburban Growth and Consequences on Landscape Function

Nita Andreea, Institute of Research of University of Bucharest, ICUB; Transdisciplinary Research Centre Landscape-Territory-Information Systems, CeLTIS, Splaiul Independentei,Bucharest, Romania; Athanasios Gavrilidis, Department of Regional Geography and*

Starting with insights on general features of suburban growth, this paper considers the fact that sprawl is a serious challenge that planners are facing worldwide. The sprawling nature of Romanian cities is particularly significant in the European context when considering the consumption models and living conditions that changed drastically after the fall of communism. Urban peripheries and metropolitan areas are the most dynamic surfaces in view of landscape function transformations. Therefore Romania has to handle several planning issues due to cities' expansion. The main issue addressed in this study is

how landscapes in the periphery of urban settlements changed and affected the quality of life. We used a structured method of assessing the link between life quality and landscape change based on questionnaires with experts and social actors. The variation of residential suburban growth and impact on landscape functionality was illustrated using three types of Romanian cities that differ in size, function and landscape amenities. Our preliminary results indicate that suburban growth is sensitive to the conditions of urban life. GIS modeling and perception analysis show that landscape patterns and loss of natural or semi-natural areas can be linked to societal attitudes toward urban quality of life.

Modeling insect outbreaks as emergent consequences of forest condition and climate

Brian R. Sturtevant, USDA Forest Service Northern Research Station Rhinelander WI; Barry J. Cooke, Canadian Forest Service Northern Forestry Centre Edmonton AB Canada; Brian Miranda, USDA Forest Service Northern Research Station Rhinelander WI*

Insect outbreaks are thought to emerge from cross-scale multi-trophic interactions influenced by both forest landscape conditions and climate drivers. Consequently insect outbreaks rank among the top uncertainties affecting future forest conditions in the context of climate change. We designed a population-based spruce budworm disturbance extension for LANDIS-II that represents a modern synthesis of past scientific paradigms. Two levels of reciprocal feedback, one for the budworm and its host tree, and one for the budworm and its natural enemies, generate the temporal dynamic, while the combination of multi-scaled dispersal (i.e., local larval dispersal and long-distance adult dispersal) and spatially auto-correlated weather perturbations generate the spatial dynamic. These spatiotemporal population patterns are further influenced by climate gradients at broader scales. Resulting model dynamics include cyclic, gradient, and eruptive outbreak behavior characteristic of spruce budworm across its range. Published defoliation impact functions translate population outbreaks into growth reductions and mortality that feed back into the succession algorithms of LANDIS-II. We show results of initial calibration and evaluation of the new extension in the Border Lakes Landscape of Minnesota and Ontario, where past research demonstrates landscape feedbacks to SBW outbreak dynamics.

Evaluating Wetland Connectivity in the Prairie Pothole Region under Climate Change Scenarios

Jennifer H. Olker, University of Minnesota Duluth; Lucinda B. Johnson, University of Minnesota Duluth; W. Carter Johnson, South Dakota State University; Glenn R. Guntenspergen, US Geological Survey*

Connectivity of wetlands and wetland complexes are essential for wetland-dependent wildlife, especially amphibians. Climate change in the Prairie Pothole Region (PPR) is predicted to variably alter wetland hydroperiod depending on ecoregion and wetland permanence (temporary, seasonal, semipermanent). We used graph theory and spatial pattern analysis to measure wetland connectivity under different scenarios of wetland persistence, with functional loss of temporary and seasonal wetlands as surrogates of projected changes in mean annual temperature and precipitation. At four study locations, representing temperature/precipitation and wetland density gradients in the PPR, functional connectivity and proportion landscape available for amphibian habitat were reduced with sequential drying and loss of temporary and seasonal wetlands. Characteristic path length increased 3-5 fold, graph diameter increased 1.5-1.6 fold, and accessible neighbors decreased to less than 14%. Network topology was greatly altered in low wetland density areas, with 70% of landscape unavailable for amphibians due to distances between remaining wetland clusters exceeding estimated dispersal capabilities (3 km). This project demonstrates how graph theory and spatial pattern analysis can be combined to develop site-specific and regional management tools by identifying corridors between wetland complexes and, at a larger scale, regions that will maintain amphibian populations.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Bridging climate science and resource management challenges by combining modeling approaches: a case study of whitebark pine in the Greater Yellowstone Ecosystem

Brian W. Miller, Department of the Interior North Central Climate Science Center & Colorado State University; Leonardo Frid, Apex Resource Management Solutions Ltd.; Tony Chang, Montana State University; Nathan Piekielek, The Pennsylvania State Universit*

Scientific tools allow us to look far into past and future climates with increasing resolution. Despite the utility of these tools for anticipating future changes and contextualizing current observations in terms of broad-scale patterns, there is often a substantial gap between the science of climate and its impacts, and more immediate and localized resource management challenges. Resource managers are frequently tasked with meeting seasonal, annual, or decadal management goals within specific management units and with limited resources. State-and-transition simulation models (STSMs) may be able to help bridge this gap due to their capacity to integrate data types, represent specific management units, and explore "what if" scenarios. However, STSMs lack statistically robust techniques to relate climate data to species, which is the strength of species distribution models (SDMs). We combined SDMs with an STSM to explore the effects of climate change on a keystone species in the Greater Yellowstone Ecosystem - whitebark pine. We used SDM output (continuous grids of species occurrence probabilities) as input for an STSM that was parameterized to capture processes of vegetation growth and disturbance. We compared historical model runs against observations, and then projected the simulation into the future. Using this combination of correlative and stochastic simulation models we were able to reproduce observations and identify key data gaps. Results indicate that SDMs and STSMs are complementary; combining them is an effective way to account for climate change impacts, biotic interactions, and disturbances, while also allowing users to explore management options and identify important research directions.

Evaluating appropriate landscape metrics for ecosystem service assessment on agricultural land uses in Sub-Saharan Africa.

Justice Nana Inkoom, Centre for Development Research, University of Bonn; Susanne Frank, Centre for Development Research, University of Bonn; Christine Furst, Centre for Development Research, University of Bonn.*

Agriculture has been the backbone of many countries in Sub-Saharan Africa, providing food for households, and fodder for animals used for ploughing agricultural lands. However the additional ecological benefits accrued from the spatially heterogeneous characters of agricultural landscapes in SSA has not been fully investigated. More specifically, methods needed to assess the role of size, shape, diversity and density, richness and evenness of agricultural landscapes towards ecosystem service provision remains scanty in the Vea catchment of Upper East, Ghana. To fully understand the role of structure and function of agricultural landscapes on agro-ecosystems provision, we calculated 32 metrics from a 2012 rapideye classification image of 9 agricultural land use classes in Fragstats to identify core set of metrics. Further, we used principal component analysis and multivariate factor analysis to eliminate redundancy and identify 10 core metrics categorized under four components: area, shape, contagion, and diversity to measure ecosystem provision. The results showed that patch and edge density, patch richness, number of patches, and Shannon's diversity were key to ecosystem service assessment. Further, we integrated the observed metrics into GISCAME to simulate and improve our understanding of the impact of the inclusion of structural metrics on ecosystem services provision under different scenarios. We suggest that a systematic understanding of spatial heterogeneity of agricultural landscapes, and the screening of core sets of landscape metrics could enhance our ability to quantify,

model, and monitor ecosystem provision under changing agricultural policies using GISCAME to enrich agricultural landscape management decisions in Sub-Saharan Africa.

Ecological networks in agricultural landscapes: an interdisciplinary approach in the French bocage

Francoise Burel, CNRS; Aude Ernoult, Universite de Rennes; Cendrine Mony, Universite de Rennes; Alain Butet, CNRS; Assu Gil-Tena, CREAF; Nathalie Herve-Fournerau, CNRS; Alexandra Langlais, CNRS; Veronique Inserguet Brisset, Universite de Rennes; Julie Bet

A recent environmental law in France,"trame verte et bleue; loi Grenelle" aims at designing ecological networks all over the country to combat habitat fragmentation as well as, protect biodiversity and ecosystem services. Regional plans for areas of high biodiversity and species richness, as well as potential corridors to connect them, have been designed and must now be implemented at the municipality scale. We developed an interdisciplinary research to study how ecological networks should be identified and which regulation policies will permit their implementation and protection. Despite a huge scientific literature on ecological networks, connectivity and corridors it is still not obvious how to identify and implement them within a given area. Using network graph theory we measured connectivity among woodlots and showed that it had no effect on woodland bird species richness but, was related to a decrease in species similarity. We developed new methods, using synthetic aperture radar (SAR) data to better describe habitat quality within corridors and improve biodiversity modelling. A parallel case study of current regulations in urban planning, environmental management and agriculture practices showed that uncertainty in identifying ecological networks brings also uncertainty in regulation making. The main tool for the moment is based on urban planning, and a specific corridor regulation exists but its application requires a strong dialog between ecological and policy sciences.

A Web-based Integrated Assessment Model to Support Policy in Europe

Paula Harrison, University of Oxford; Mark Rounsevell, University of Edinburgh; Marc Metzger, University of Edinburgh*

Decision-makers and other interested citizens need to be able to access reliable science-based information to help them respond to the risks of climate change impacts on ecosystems services and assess opportunities for adaptation. Participatory integrated assessment (IA) tools combine knowledge from diverse scientific disciplines, take account of the value and importance of stakeholder 'lay insight' and facilitate a two-way iterative process of exploration of "what if's" to enable decision-makers to test ideas and improve their understanding of the complex issues surrounding ecosystem service assessment and adaptation to climate change. The CLIMSAVE IA Platform is a web-based participatory IA tool which allows stakeholders to assess climate change adaptation for a range of ecosystem services from the agricultural, forestry, biodiversity, coastal, water and urban sectors. The integrated assessment approach enables trade-offs between different ecosystem services to be explored, highlighting the importance of taking account of the complex interactions between different sectors under different scenario futures in planning adaptation responses. This presentation will interactively guide participants through simulation of (1) potential impacts under scenarios of climate and/or socio-economic change, (2) identification of sectoral and multi-sectoral vulnerability 'hotspots', (3) the potential for adaptation to reduce impacts, and (4) the cost-effectiveness of adaptation measures.

A comparative socio-ecological study of Cape Town, South Africa and New Orleans, Louisiana, USA

Henrik Ernstson, University of Cape Town and Stockholm Resilience Center; Joshua Lewis, Stockholm Resilience Center; Wayne C. Zipperer, USDA Forest Service;Thomas Elmqvist, Stockholm Resilience Center*

"Socioecological Movements in Urbanized Ecosystems" (MOVE) is an international comparative study, funded by the Swedish Research Council Formas. Based in Cape own, South Africa, and New Orleans, USA, MOVE examined the role of civic collective action and racial segregation on shaping the ecological outcomes we observe today. . In Cape Town, we examined the impact of shifting land use and urbanization patterns occurring after apartheid government ended in 1994. We examined how civic groups acting on environmental concerns were embedded in a wider city-wide network of civic groups and formal agencies. By comparing findings with earlier work by team members in Glasgow and Bistol, UK, the network analysis showed a profile of civil society consisting of a cluster of interested groups acting as independent organizations on their on specific agendas, and various clusters with high degree of internal cohesiveness and network complexity but largely disconnected from each other. Ecologically, diversity, species occurrence, and distribution were aligned within different social contexts with wealthy and predominantly white communities having higher vegetative diversity, and informal settlements with the least diversity. In New Orleans, we examined urbanization of a partially drained estuary, and focused on how Hurricane Katrina and earlier flooding disturbances have driven the socio-ecological trajectory of the estuary. Civic collective actions were explored through historical research and ethnographic studies of land use politics over the past decade. Vegetation patterns showed spatial differentiation that aligned with racial demography, municipal governance, 2005 flooding depth, and the density of resident resettlement after Katrina.

Concluding Discussion

Patrick James, Universite de Montreal*

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An overview of the contributions of landscape genetics to connectivity research in terrestrial animals

Lisette P Waits, University of Idaho; Stephen Spear, Orianne Society; Sam Cushman, US Forest Service*

Landscape genetic studies have focused on terrestrial animals more than any other taxonomic group creating a wealth of information about how animals respond to different landscape and environmental features. Elucidating landscape effects on movement and gene flow is crucial in ecology, evolution and conservation, and landscape genetic approaches are particularly well-suited for increasing our understanding of effective dispersal. This talk will present an overview of what we have learned about from over ten years of studies that address broad questions about landscape and environmental effects on connectivity of terrestrial animals such as detecting barriers, identifying corridors, examining population dynamics and predicting response to environmental change. Based on this overview, we highlight successes and limitations of current research approaches, and present case studies that have specifically dealt with some of these limitations when testing ecological hypotheses about gene flow in heterogeneous landscapes.

Forest structures and composition of importance to biodiversity â€“ Recent advances in quantifying historical abundance

Matts Lindbladh Southern Swedish Forest Research Centre SLU - Swedish University of Agricultural Sciences*

The importance of long-term historical information has long been recognized as a fundamental aspect of effective conservation. However, there remains some uncertainty regarding the extent to which paleoecology can quantify the past abundance of forest attributes of high conservation priority. Here

we present recent advances in three key areas. First, the large number of pollen sites available in some regions now allow for precise estimates of the former occurrence and distribution of tree species. Pollen percentage data from 42 sites in southern Sweden show that the extinction of Tilia (basswood) from the region had different drivers (climate vs. human impact) in two adjacent vegetation zones. Second, recent advances in modelling pollen productivity and dispersal has made it possible, with high reliability, to estimate former openness. In contrast, pollen percentages in isolation, largely underestimate former openness. Finally, data on past occurrence of dead wood and age dynamics is difficult to collect, and essentially lacking in the scientific literature. However, subfossil beetles have the capacity to illuminate structural and habitat changes of relevance for biodiversity not possible to achieve with other proxy data. We present data from a forest reserve rich in dead wood in southern Sweden where over 4000 subfossil beetles were sampled from the last 1000 years, of which 23 are red-listed today. The number of beetles dependent on CWD has decreased significantly since the Middle Ages, and todaysâ€™ diversity of saproxylic beetles is only a remnant of that found within the â€œwild woodsâ€ of 500 to 1000 years ago.

Provision of ecotourism opportunities and destination images related to ecologically important landscape structures in Uganda's mountainous regions

Deus Kamunyu Muhwezi, Makerere University; Tommaso Sitzia, University of Padova*

More than 70% of Uganda's population lives in rural areas and depends on water, soil and biodiversity for its livelihood. However, the rapid economic growth has brought widespread deforestation and wetland degradation. Community use of plants for food, fodder or medicine offers opportunities for landscape-scale conservation and ecotourism. Therefore, community-based ecotourism is a key driver of a more sustainable development. However, the volatility of the global travel market and the homogeneity in destination needs to strengthen the appeal and originality of Uganda's tourism product. Thise contribution aims at to relateing Ugandan mountainous landscape patterns to their biological and cultural diversity and to the perception that visitors and local communities might have. This approach aims to promote a classification of Ugandan landscapes into types which are whose character is the result of the action and interaction of natural and human factors. ItWe reminds review existing landscape international conventions, and we suggest to recognisinge landscapes in Ugandan law as an essential component of people's surroundings. The traditional focus of tourism should shift from single destinations to landscapes as a result of shared cultural and natural heritage, and a foundation of the community identity, a transformation where ecotourism activities will play a role.

Linking Terrestrial Carbon with Aquatic Carbon Through Biogeochemical and Soil Erosion Models

Jinxun Liu, Ecodyn Solutions, contractor to USGS; San Jose State University Research Foundation; Benjamin Sleeter, USGS, Western Geographic Science Center; Sarah Stackpoole, USGS, Denver Federal Center; Zhiliang Zhu, USGS, Reston; Tamara Wilson, USGS*

Climate, natural disturbance, and human land use are dynamic factors influencing surface runoff and soil erosion. Currently, there is relatively good understanding of the overall rates of soil erosion and carbon delivery from land to aquatic system. However, our knowledge of the spatial and temporal variability of soil and carbon movement across the landscape is still limited. In this study, we used the parallel Integrated Biosphere Simulator (pIBIS) and the Unit Stream Power-based Erosion Deposition (USPED) model to produce litter carbon, soil carbon, runoff, and soil erosion values. We evaluated model output relative to empirical runoff and suspended sediment data from selected watersheds to link carbon transport between terrestrial and aquatic carbon environments. The 90-m resolution USGS HydroSHEDS DEM was used in USPED to calculate flow accumulation. The SSURGO soil erodibility K factor map was

used as the constant k-factor of the USPED model. Land cover change data from 1973 to 2010 are generated from the Land Use and Carbon Scenario Simulator (LUCAS) and converted to an annual input map indicating the land cover change and its effect on soil erosion. Annual rainfall from PRISM data were used to modify the erosivity R factor map for USPED, by which the base erosivity map was modified by actual annual rainfall variation. The pIBIS simulation was performed at 960-m spatial resolution with LUCAS land cover data, PRISM climate data, SSURGO soil data and other additional data. Annual carbon output from pIBIS was fed to the 90-m USPED model. The USPED output is aggregated to 960-m as annual feedback to IBIS. Linking the impacts of soil erosion across terrestrial and aquatic environments provides a better understanding of the vulnerability of soil organic C pools and helps to define the main drivers behind soil C loss rates from the terrestrial landscape.

Downscaling numerical simulation of the impact of landscape change on regional climatic elements

Qian Cao, Deyong Yu -Center for Human-Environment System Sustainability, Beijing Normal University*

Human activities have shifted the landscape drastically. To improve the understanding of the impact of landscape change on the climate over the Agro-Pastoral Transitional Zone of North China (APTZNC), the spatial distribution of four land surface biophysical parameters, the fractional vegetation cover (FVC), leaf area index (LAI), albedo (ALB) and emissivity (EMS), of 2001 and 2010 derived from remote sensed data were assimilated into the Weather Research and Forecasting (WRF) model. Generally, the albedo decreased and FVC increased, while the change on LAI and EMS depended on different seasons. As a consequence, the annual mean air temperature decreased by 0.2Â°ÂºC and precipitation increased by 10 mm, and the summer temperature and precipitation change were the main contributors to the annual change. The simulation results also illustrated that rational arrangement of farming, grazing and ecological restoration measures was crucial to climate change adaptation, and the results provided a reference for regional landscape planning to achieve the sustainable goals in the arid and semi-arid region.

From restoration to resilience ecology: Rapid ecosystem shifts are triggered by interactions of landscape disturbance and climate change

Donald A. Falk, University of Arizona, Associate Professor, School of Natural Resources and the Environment; Associate Professor of Dendrochronology, Laboratory of Tree Ring Research*

The role of disturbance in western frequent-fire ecosystems is well established, but the extent to which this includes high-severity fire has been debated. Most studies of historical fire regimes in dry and moderate forest types indicate low- to mixed-severity fire regimes, with high-severity fire occurring in smaller, isolated patches. This understanding becomes critical as we face the challenge of maintaining viable forests in the coming centuries. Modeling and empirical studies predict changes in tree species distributions in response to changing climate, likely expressed at multi-annual to decadal time scales. In contrast, severe large-scale disturbances can reorganize ecosystems on much shorter time scales of days to months. We review the impacts of multiple successive fires and post-fire succession in southwestern North America, which are leaving large areas of landscape with nearly total tree mortality. The emerging combination of climate change and severe disturbance is likely to trigger abrupt ecosystem transitions into novel configurations, exceeding the effects of either factor acting separately. These new configurations can be resilient in their new state, resist return to pre-disturbance conditions. Such abrupt transitions are predicted to become more common under conditions of altered future climate and amplified disturbance regimes: climate provides the envelope within which these dynamics occur, but disturbance provides the trigger for abrupt system reorganization. We explore the implications of potentially irreversible ecosystem responses for science and practice of ecological restoration in the

coming century, and the emergence of resilience ecology as a new paradigm in the evolution of restoration ecology.

Multi-scale heterogeneity and grassland birds: Some simplistic generalizations relating structural complexity to avian community attributes

Jim Miller, University of Illinois; Courtney Duchardt, Missouri Department of Conservation; Torre Hovick, North Dakota State University; Tim Lyons, University of Illinois; Finn Pillsbury, New Mexico State University*

John Wiens' masterwork, Spatial Scaling in Ecology, was not created in a vacuum. Rather, the paper builds on the thinking of the author's contemporaries in ecology at the time, and on work by individuals in an impressive variety of other disciplines. This classic paper is also rooted in Dr. Wiens' earlier efforts, extending back to his research on grassland birds and a series of seminal papers published in the 1970s. During that period, Dr. Wiens was especially focused on the relationship between heterogeneity at multiple scales and community dynamics. Here, I revisit some of his findings in the context of research that my graduate students and I have been conducting since 2006 - work that entails the use of fire and grazing to enhance habitat conditions for grassland birds. I discuss the effects of heterogeneity within pastures on habitat use and breeding success, as mediated by habitat diversity in the landscape matrix.

Sustainable use and biocultural diversity in satoyama landscapes on the shores of Lake Biwa, Shiga, Japan

Fukamachi Katsue (Kyoto University) & Oku Hirokazu (University of Toyama)

Satoyama landscapes provide diverse habitats for plants and animals, are rich in biodiversity, and are home to distinctive cultural features and centuries-old agricultural wisdom. They significantly contribute to the cultural diversity of the world. Unfortunately, during the last few decades, many of these bioculturally rich landscapes have disappeared as a result of economic development, landscape standardization, or abandonment. In recent years, however, the importance of satoyama as well-functioning ecosystems rich in biocultural diversity has been widely recognized, and efforts to preserve satoyama have been made. In Japan, measures taken include the 2004 revision of Japan's Cultural Properties Law based on which satoyama can be designated as a cultural property. In our presentation, we will reevaluate Japan's satoyama from an international viewpoint, and find ways to continue and to newly build connections between satoyama and the people who live in satoyama landscapes on the shores of Lake Biwa, Shiga, Japan. Based on what we find, we then discuss an image of the future locally distinctive satoyama, and seek techniques and a system that will help putting the image into reality.

The potential of a reforesting landscape to restore floristic biodiversity: a modelling approach in the Ecuadorian Andes

Romaike S. Middendorp, Earth & Life Institute, University of Louvain, Belgium; Alvaro J. PÃ©rez, Herbario QCA, Pontificia Universidad CatÃ³lica, Quito, Ecuador; Alvaro Molina, Department of Earth and Environmental Sciences, KU Leuven, Belgium; Eric F. La*

Secondary growth forests are rapidly expanding in the Tropics. There is an increasing recognition that forest transitions have the potential to restore biodiversity at the landscape scale. Spatial targeting of land use policies could improve the biodiversity benefits of reforesting landscapes. The objective of this research was to better understand the relative importance of landscape patterns in influencing the potential of reforesting landscapes to restore native floristic biodiversity. We conducted this research in the Pangor watershed in the Ecuadorian Andes, where a net forest cover increase was observed in the

past decades. We developed various land-use scenarios that differed in spatial patterns of reforestation. We simulated the restoration of floristic biodiversity for each scenario using LANDIS-II, a process-based model of forest dynamics. Based on a pair-case comparison of each scenario against a random scenario, we showed that simulated species richness in secondary forest was considerably higher when occurring in: (i) close proximity to remnant forests; (ii) areas with a high percentage of surrounding forest cover; and (iii) spatially heterogeneous landscapes. Also, the altitude range in which reforestation took place affected the restoration of species richness. Policies promoting reforestation in this watershed may improve their benefits for floristic biodiversity when accounting for landscape attributes. Our research contributes to a better understanding of the recolonization processes of regenerating forests and provides a scientific basis for the design of reforestation projects that enhance biodiversity restoration in human-modiï¬ed landscapes.

Linking Metrics of Landscape Pattern to Hydrological Process in a lotic Wetland

Jing Yuan, School of Natural Resources and Environment, University of Florida; Matthew J. Cohen, Ecohydrology Laboratory, School of Forest Resources and Conservation, University of Florida; David A. Kaplan, Dept. of Environmental Engineering Sciences, Uni

Strong reciprocal interactions exist between landscape patterns and ecological processes. In wetlands, and particularly flowing systems, hydrology is the dominant abiotic driver of ecological processes and both controls, and is controlled, by vegetation presence and patterning. We focus on binary patterning in the Everglades ridge-slough landscape, where longitudinally connected flow, principally in sloughs, is integral to landscape function. Patterning controls discharge competence (i.e., the ability to route water) in this low-gradient peatland, with important feedbacks on hydroperiod and thus peat accretion and patch transitions. Our goal was to quantitatively predict pattern effects on hydrologic connectivity and thus hydroperiod, a core objective of ecosystem restoration. We evaluated three pattern metrics that vary in their hydrologic specificity. The first, Landscape Discharge Competence (LDC), considers elongation and patch-type density that capture geostatistical landscape features, but does not explicitly account for hydrologic connectivity flowpaths. A second, the Directional Connectivity Index (DCI), extracts both flow path and direction from a rasterized landscape based on graph theory. The third, least flow cost (LFC), is based on a global spatial distance algorithm strongly analogous to landscape water routing, where ridges have higher flow cost than sloughs because of their elevation and vegetation structure. Metrics were evaluated in comparison to hydroperiod estimated using a numerically intensive hydrologic model (SWIFT2D) for synthetic landscapes (4 anisotropy levels, 7 ridge density levels). Both LFC and DCI were excellent predictors of hydroperiod (r2 = 0.92 and 0.88, respectively); LDC was less successful (r2 = 0.69), likely because landscape geostatistical attributes and flow connectivity are correlated but distinct properties. Later, fitted relationships between metrics and hydroperiod for synthetic landscapes were extrapolated to both contemporary and historical maps (1940 to 2004) to explore hydroperiod trends in space and time. Both LFC and DCI were useful for diagnosing how the modern landscape has, in some areas, reorganized in response to modified hydrology. Metric simplicity and performance indicates potential to provide hydrologically explicit, computationally simple, and spatially independent predictions of landscape hydrology, and thus provide an measure of restoration performance.

Developments in the Application of Species Distribution Models for Understanding Human Caused Disturbance and Habitat Change across Forested Landscapes

Chris J. Johnson, Natural Resources and Environmental Studies Institute, University of Northern British Columbia; Michael Bridger, NRES Graduate Program, University of Northern British Columbia; Michael P. Gillingham, Natural Resources and Environmental*

Species distribution models are now used widely in landscape ecology for understanding a range of ecological phenomena across a diverse set of taxa. This technique, premised on both statistical and spatial analysis, is inherently general, accommodating numerous types of data. There is now a deep literature with examples of applications that range from fundamental questions in theoretical ecology to more practical problems related to the recovery of species. We present contemporary advances in the application of species distribution models for understanding and managing landscape change for terrestrial wildlife. This includes an application of expert-based models for quantifying the impacts of forest harvest for several furbearer species in British Columbia, Canada. Also, we present methods and findings focused on quantifying empirical zones of disturbance as they influence the distribution and quality of habitat for woodland caribou over time.

Multi-Scale Influences of Environmental Variability on Life History Strategies of the Oklahoma Salamander, Eurycea tynerensis

Michael L. Treglia, Samuel D. Martin, Austin L. Boardman, Ronald M. Bonett -Department of Biological Science, The University of Tulsa, Oklahoma NSF-EPSCoR Program*

Local and regional environmental conditions influence species' distributions, and for amphibians, these factors tend to be associated with different life-history strategies. Many salamander species exhibit one of two strategies, either metamorphosing from aquatic larvae into terrestrial adults, or exhibiting paedomorphosis, in which individuals retain larval traits and remain aquatic throughout their lives. It has been suggested that stable aquatic conditions and variable terrestrial conditions are conducive to the evolution of paedomorphosis, though most studies to date have only analyzed associations with terrestrial or aquatic conditions, largely with pond-associated species. We studied the Oklahoma Salamander (Eurycea tynerensis), found in small streams of the Ozark Plateau in the south-central United States. Populations of E. tynerensis can be metamorphic or paedomorphic, and paedomorphosis has evolved multiple times within this species, making it an ideal model for investigating relationships between environmental conditions and life-history strategies. We deployed automated dataloggers to characterize temperature regimes of stream habitats for 23 sites containing paedomorphic or metamorphic E. tynerensis over the course of one year, and we obtained regional climate data from bioclimatic layers in the WordClim dataset. We used multivariate analyses to test hypotheses that paedormophosis is associated with more stable stream temperatures and more variable climates. Paedomorphic E. tynerensis were significantly associated with streams with more stable temperatures, whereas metamorphic populations were significantly associated with more stable climatic conditions. Functional relationships between environmental stability and life-history strategy should be confirmed using common-garden experiments, though our findings may aid in climate-change projections for the species.

Recent land use change is concentrated around U.S. ethanol refineries

**Christopher K. Wright, Natural Resources Research Institute, University of Minnesota, Duluth*

Under the U.S. Renewable Fuels Standard v2 (RFS2), biofuel feedstocks cannot be sourced from lands cleared or cultivated prior to enactment of the 2007 Energy Independence and Security Act. This regulation is designed to prevent carbon emissions from previously untilled soils and to protect grassland biodiversity. Recent studies have shown substantial agricultural expansion during the period of RFS2 enactment. Here, the USDA Cropland Data Layer is used to examine land cover land use change (LCLUC) in proximity to all actively-producing U.S. corn ethanol refineries over the period 2008-2012.

The rate of conversion of non-cropland to cropland increases with greater proximity to refinery locations. This LCLUC is occurring overwhelmingly on grass-dominated land cover types and most new cropland is being put into corn and soybean production. This result suggests that corn ethanol feedstocks are being sourced from ineligible lands in a way that is not being detected under the current regulatory framework used by the Environmental Protection Agency.

Analysis of ecosystem services in Russia - a conceptual overview

Karsten Grunewald, Leibniz Institute of Ecological Urban and Regional Development, Elena N. Bukvareva, Alexey V. Zimenko, Biodiversity Conservation Center Moscow Heinrich Schmauder, Bundesamt fur Naturschutz

The paper summarizes the status of TEEB-related processes (The Economics of Ecosystems and Biodiversity), and the national assessment of ecosystems and their services in Russia, as a preliminary result of the Russian-German project "TEEBi-Russ: Valuation of Ecosystem Services (ES) in Russia, First Steps." The planned structure of a prototype of a National Report on ES in Russia is presented. As a first step, a methodology for assessing the services for the federal subjects of Russia was chosen. Russia harbors a great diversity of natural conditions and ecosystems which are suppliers of ES, and a like variety of the socio-economic conditions that shape the demand for these services and their consumption. In order to take into account the heterogeneity of these two factors, a first estimation of the volume of services provided by ecosystems on the one hand, and their consumption on the other was realized. The approach provided permits several important tasks to be addressed: the evaluation of the degree of satisfaction of people's needs for ES, the identification of the ecological donor and acceptor regions, and the zoning of the country's territory for ES assessment.

Non-wood forest products and services as a way to sustain landscape management and habitat conservation in European mountain areas

Giulia Corradini, TESAF Deparment University of Padova; Enrico Vidale, TESAF Deparment University of Padova; Riccardo Da Re, TESAF Deparment University of Padova; Davide Pettenella, TESAF Deparment University of Padova*

Forest cover is the result of interactions between abiotic (e.g. climate) and biotic factors. Among the latter, in European mountains, forest management and farming have strongly shaped forest landscapes. Today, due to the decreased profitability of traditional mountain farming and silvicultural practices, the land pattern composed by forests, crop and grazing farmlands is experiencing a vast process of change, with farmland abandonment and spontaneous reforestation. The reduction of forest activities, beyond meaning a loss for rural economy, and besides altering the landscape function value, is having consequences for several animals and plants in terms of changes in species composition, distribution and behaviour. In the last 20 years, a growing interest towards Non-Wood Forest Products and Services (NWFP&S) has been visible throughout Europe. Driven by factors such as the decreasing profitability of wood production in semi-natural forests, the growing demand for environmentally-friendly and locally grown products, and supported by policies financing the rural development, NWFP&S can play an important role in stimulating forest-based enterprises in mountain areas. Selling recreational services, e.g. mushrooms picking permits, can represent an important source of income for forest managers, more relevant than timber sales. Enhancing the offer of NWFP&S could help in providing a stable income flow, contributing to finance the rural economy, thus reducing the cost of mountain forests and related habitats management and conservation. The paper aims at to provideproviding evidence of these trends, presenting the results of the first large EU financed research project on NWFP&S, StarTree (http://star-tree.eu/).

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Retrieving angular gap fraction and light environment of forest canopy using terrestrial laser scanning data

Zheng, Guang, Nanjing University Kong, Fanhuang, Nanjing University Ma, Lixia, Nanjing University*

The spatial distribution of the photosynthetic tissues of a forest canopy plays a key role in the ecological related processes such as gas exchange, photosynthesis, and evapotranspiration through affecting the radiation regime. However, accurately and quantitatively describing the woody materials' contribution to effective leaf area index (LAIe) estimation from the 3-D perspective is a challenging work. In this work, the differences between the directional and angular gap fractions were first identified, then a generic pattern-recognition based classification algorithm was developed to automatically classify the forest point cloud data (PCD) obtained from terrestrial laser scanning (TLS) system into three different classes including linear (i.e. stems and branches points) class, surface (i.e. ground points) class, and random (i.e. leaves and grass points) class. In the meantime, a new method termed "radial hemispherical point cloud data slicing" algorithm was proposed to investigate the spatial distribution pattern of a forest canopy PCD in three dimensional (3-D) real space. Our results showed that a relative stable range for the angular resolution was suitable for calculating the angular gap fraction, and the contribution of woody materials to LAIe estimation varied from around 19 % to 54 % with the varied forest stand densities. Moreover, the TLS-based LAIe could account for 74.27 % variation of DHP-based LAIe with the linear regression statistical model. This work provides a theoretical foundation for true LAI estimation based on the PCD generated using TLS system, and facilitates the application of TLS system on retrieving 3-D forest canopy structural biophysical parameters.

Integration of Landscape Eco-planning and Ecological Restoration: Application of an Evaluation Index System of Ecological River in Chongming Island

Jianhua Li, Tongji University; Haiyang Fang, Tongji University.*

According to the theory of "Anti-planning", the objective and importance of ecological river construction does not only reflect on landscape eco-planning, but also provides river habitats protection and ecosystem services. The strategic orientation of Chongming Island (has a total length of 9352.3km of river network, longer than 6380km of Yangtze River), in Shanghai, is to make it a world-class ecological island. However Chongming river construction remains the phenomena of channelization and revetment artificialization etc. Therefore a proposal for a set of an evaluation index system for an ecological river has become an important application value for the combination of landscape eco-planning and ecological restoration. Based on the connotation of ecological river, an evaluation index system with a total of 30 indicators was established and it contained 5 aspects of physical integrity, biological integrity, chemical integrity, hydrology and water conservancy, social function. In the case of No.4 River in the Chenjia Town of Chongming Island, the evaluation includes both sides of the river by applying a fuzzy comprehensive evaluation model based on an analytical hierarchy process (AHP). After grading according to the optimal level (level 1), the results showed that 71% of river was at grade 3 while 29% was at grade 4 of all the 5 grades.

Evaluating resistance surfaces for wildlife

Kathy A. Zeller, Kevin McGarigal -Department of Environmental Conservation, University of Massachusetts, Amherst; Paul Beier, School of Forestry, Northern Arizona University; Samuel A. Cushman, U.S. Forest Service, Rocky Mountain Research Station; T. Win*

Resistance surfaces are often used in metapopulation and connectivity studies to represent the landscape between individuals, populations or habitat patches. They are also the basis for wildlife corridor modeling. Despite their important role in conservation efforts, there is currently no general consensus on the most appropriate biological data type(s) or method(s) for quantifying resistance to movement. To address this shortcoming, we present a method for evaluating the performance of resistance surfaces. We used this approach to compare 26 resistance surfaces for pumas (Puma concolor) derived from point and path selection functions at multiple scales. Evaluation consisted of the following steps, 1) landscape resistance was quantified in a cross-validation framework, holding out one individual at a time, 2) the cost along the resistance surface for that individual's entire movement path was calculated, 3) the cost along the resistance surface for available paths was calculated and averaged, 4) the used and available costs were averaged across individuals and standardized, and 5) the used and available costs were differenced for each resistance surface. The resistance surface that best represented the lowest movement costs for individuals was the one with the greatest negative difference between the used and available costs. This relatively simple method can be applied with high resolution GPS collar data to evaluate which combination of data types and methods produces the most suitable resistance surface for a species. Information such as this will assist in identifying the most functional corridors for wildlife movement and conservation.

Landscape ecology; A science for practitioners?

Gesine Jimenez Martinez, Norwegian Forest and Landscape Institute; Wenche E. Dramstad, Norwegian Forest and Landscape Institute; Isabel Loupa-Ramos, IST/University of Lisbon*

Several authors working in different disciplines have pointed to the existence of both a science - policy, and also a science - practice gap. In the study presented here we wanted to look at the science of landscape ecology and practical applications of scientific landscape ecological findings in landscape design and planning. We wanted to see the extent to which such examples were easily accessible and appeared well documented in events promoted by IALE in Europe. Having first defined what we meant by "application" in this context, we conducted our study as a review of proceedings from European IALE meetings and conferences. We did find different examples of practical applications; however, they were fewer than anticipated keeping the stated ambition of landscape ecology being "â€¦the scientific basis for the analysis, planning and management of the landscapes" in mind. While there may be other locations (i.e. journals, conferences) where examples are published and well documented, based on our results we will at least claim that they are not easily found and not very accessible. In our perspective this is unfortunate. It makes it difficult for those new to the field to find good illustrative examples, useful e.g. to convince project owners. It also hinders the "learning by doing" effect, in particular when it comes to finding creative, well-functioning solutions. We suggest, therefore, that there is a need to focus on ensuring a higher accessibility and finding a more practitioner-friendly way of communicating scientific findings.

Temporal-spatial Characteristics of World Cultural Landscape Heritage and the conservation of Honghe Hani Rice Terraces

Yuanmei JIAO,School of Tourism and Geography Science, Yunnan Normal University, Kunming, China.

Cultural landscapes have been formally acknowledged as world heritage by UNESCO in 1992. Since then to 2013, 85 cultural landscape heritages have been inscribed in world cultural heritage list. In this paper, we collects data of all the cultural landscape heritage sites via UNESCO's official website, analyzes the spatial and temporal characteristics, the evaluation criteria and the types of the world cultural landscape heritages. Taking the Honghe Hani Rice Terraces as a case, we discuss the challenges to conserve world

cultural landscape heritages. The results indicate: (1) The amount of cultural landscape heritage sites keeps increasing steadily since 1992. (2) The cultural landscape heritage sites are mainly located in developed countries in mid-Northern latitudes. In the global political and economic culture partition, cultural landscape heritage in European and American area is more than 50% of the world. (3) The 85 heritage were conformed to the evaluation standard mostly on iii, iv and v. It shows that evaluation of the cultural landscape heritage is focus on the continuous evolution. (4) The world cultural landscape heritage will increase and relatively keep balance in spatial distribution in future. Re-classification of cultural landscape heritage types will facilitate the submission and protection of them. (5) Honghe Hani Rice Terraces was listed in world cultural heritage in 22 June 2013 which inscribes on the basis of criteria (iii) and (v) with the outstanding universal values. It's conservation should be an integrated serial strategies of agriculture production, natural resources such as water, forests protection, eco-tourism development and poverty elimination.

Issues and Challenges with regards to the Implementation of Green Infrastructure Concept in Japan

Sadahisa Kato, Ibaraki University

In landscape planning, the concept of green infrastructure has emerged as a way to provide multiple environmental, social, and economic benefits to urban residents by an integrated, connected network of green and open spaces and waterways toward the goal of making cities more sustainable. Although green infrastructure concept and practice has gained popularity in North America, the UK, and Europe, its systematic implementation in Japan and Japanese urban planning policies is yet to be seen. This presentation focuses on the issues and challenges surrounding green infrastructure implementation in Japan and presents a way forward. These issues include, for example, Asia monsoon style rainfall pattern, total annual precipitation, coincidence of the annual rainfall peak with vegetation growth, academic and bureaucratic silos, and a lack of watershed-based planning in Japan. The implementation of green infrastructure requires a transdisciplinary and adaptive approach. The author illustrates a couple of successful cases of green infrastructure application to stream restoration and identifies key components and opportunities for green infrastructure implementation in Japan, where the discussion of the needs for compact cities, utilization of abandoned fields and vacant housings, and capturing the opportunities for conventional infrastructure renovation is drawing much attention lately, under a matured and rapidly aging society.

Final Discussion with all speakers

Christian Albert, Leibniz Universitat Hannover & Helmholtz Centre for Environmental Research - UFZ; Vivek Shandas, Portland State University; Wei-Ning Xiang, University of North Carolina at Charlotte & East China Normal University*

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Fire-Prone Landscapes as Coupled Human and Natural Systems: An example from central Oregon

Thomas Spies, Pacific Northwest Research Station; FPF Research Team, Pacific Northwest Research Station and Oregon State University*

Fire-prone landscapes are not well-understood as coupled-human and natural systems and present many challenges for managers and developing adaptive behaviors and institutions. We explore how heterogeneity, feedbacks, and external drivers in this type of natural hazard system can lead to complexity and limit the development of more adaptive approaches to policy and management. Institutions and social networks may be able to counter these limitations and promote adaptation. We

present a conceptual model that includes a robust characterization of social subsystems for a fire-prone landscape in central Oregon and characterize how we are using an agent-based model to promote understanding of this social-ecological system. Our model incorporates existing ecological models of vegetation and fire and is based on empirical studies of land owner decision making. Our findings demonstrate that alternative management strategies can lead to very different landscape outcomes for socio-economic and biodiversity metrics. For example, scenarios with no restoration treatment had more high severity fire than those with treatments. Tradeoffs between restoration (e.g. more open forests with large fire-resistant trees) and habitat of species that require dense older forests were evident. The model can be used in collaborative settings to facilitate discussion and development of more effective policies and practices for fire-prone landscapes.

Adding mechanism to computational landscape science: When and how much?

Timothy H. Keitt, University of Texas at Austin*

When and how to introduce mechanistic detail into computational models is a fundamental issue for landscape ecologists. I examine this issue from a number of perspectives using examples from my own work and ask whether there is an optimal level of mechanism in models and how can we decide when adding mechanistic details help or hinders our efforts. Answering these questions is difficult as investigators often have different working definitions of what constitutes a mechanism. I will offer some guidance in defining mechanisms and when and how to introduce them into models. Along the way I will touch on several recent studies from my lab in climate change, genomics and landscape connectivity.

Combining aquatic environmental DNA and landscape genetics to assess functional connectivity of the at-risk Arizona treefrog.

Caren S. Goldberg, Washington State University; Meryl C. Mims, University of Washington; Katherine M. Strickler, Washington State University; Julian D. Olden, University of Washington

Recent years have witnessed the growing promise of environmental DNA (eDNA) detection of organisms in research and monitoring applications globally. In this study, we combined eDNA methods, field surveys, and landscape genetic analyses of tissue samples to investigate the distribution and functional connectivity of a rare amphibian, the Arizona treefrog (Hyla wrightorum). The southern Arizona population of the Arizona treefrog is a candidate for listing under the U.S. Endangered Species Act and the focus of conservation efforts in its small range across a grassland/oak forest ecotone. Few occupied sites for this species are known and many historical surveys recorded only one or two individuals. In summer 2014, we discovered several previously unknown breeding populations in the field, sampled sites where the species was not visually detected using eDNA to search for additional occupancy, and collected tissue samples from all known populations for landscape genetic analyses. For eDNA analysis, we collected four replicate samples using 0.45 Âµm cellulose nitrate filters and employed a species-specific qPCR assay. We employed multiple landscape genetic approaches to examine relationships between population genetic structure and landscape and hydrologic connectivity. These combined results elucidate occupancy and functional connectivity across the landscape for this rare amphibian and demonstrate the utility of eDNA as a complementary tool for investigating the ecology of rare and elusive species.

Introduction to Part II

Paul Opdam, Alterra Wageningen UR; Netherlands

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The driving forces of landscape change in Europe: A systematic review of the evidence

Tobias Plieninger, University of Copenhagen

The number of studies on the driving forces of landscape change in Europe has grown considerably. However, the understanding of the drivers of landscape change remains challenged because of the strong variation of existing case studies over disparate spatial and temporal scales and the current fragmentation and dispersal of landscape research across many domains and disciplines. Integration of this knowledge is needed as landscape is the most relevant scale to address real-world sustainability problems. The aim of this presentation is to provide a first systematic synthesis of the underlying drivers and proximate causes of landscape change across Europe. Our systematic review of the literature on landscape change identifies and catalogues available knowledge from a wide variety of sources. In particular, the review aims: (1) to characterize how underlying drivers and proximate causes of landscape change have been addressed in empirical case studies; (2) to identify and classify the most important drivers and causes of change in European landscapes; (3) to evaluate which types of actors are considered in landscape change studies and how their role is assessed; and (4) to examine existing biases in the scientific literature related to particular environmental, land-use, and socio-economic attributes.

Changes in distribution pattern of plant functional group responding to the global change in alpine tundra, Changbai Mountain, China

XU Jiawei, School of Geographical Science, Northeast Normal Universityï¼›JIN Yinghua, School of Geographical Science, Northeast Normal Universityï¼›Zong Shengwei, School of Geographical Science, Northeast Normal University*

Alpine tundra in the Changbai Mountains located at the humid areas in eastern China, which is a sensitive region responding to climate change. Subtle changes in climate may result in great changes in vegetation of alpine tundra. Based on the survey data of 30 years' monitor work, and through 4 years' simulated experiments, we obtained the discipline of changes in distribution pattern of plant functional group in the alpine tundra under the background of global climate warming. The effects of global change on the alpine tundra were determined as follows: climate warming (CW), snowmelt period shorten (SPS), nitrogen addition (NA), and water erosion caused by frequent heavy rains (WRbR), and divided into two types: multi-effect and mono-effect, which was attributed to the expansion of herb plants, such as Deyeuxia angustifolia, Sanguisorba officinalis, Veratrum oxysepalum, Geranium wilfordii, Bupleurum euphorbioides, Aconitum carmichaeli, etc. Changes in distribution pattern of the functional group represented by D. angustifolia were affected by CW, SPS, NA, and WRbR. Changes in distribution pattern of the functional group represented by S. officinalis were affected by CW, SPS, and WRbR. Changes in distribution pattern of the functional group represented by V. oxysepalum were affected by SPS. Changes in distribution pattern of the functional group represented by G. wilfordii were affected by WRbR. Changes in distribution pattern of the functional group represented by B. euphorbioides were affected by CW and WRbR. Changes in distribution pattern of the functional group represented by A. carmichaeli were affected by CW.

Linking individual and community levels in social-ecological networks by information about landscape services

Paul Opdam, Alterra Wageningen UR

Because the majority of ecosystem services requires landscape level ecological networks to provide benefits in an effective and reliable way, managing landscapes for ecosystem services (here called landscape services) demand coordinated interventions at the landscape level. Actors need to collaborate at the landscape level. In the absence of a strong leading role by a government, as is the case in an increasing number of countries, there is a need for other mechanisms enhancing such collaboration. In this contribution I will explore how information on multiple landscape service benefits potentially provided by the ecological network, and information about the spatial dependency of providing these benefits, could enhance collaboration between local landscape actors. I will show examples from ongoing cases studies and literature to illustrate how information provided by scientists may inspire actors to create collaborative relationships and decide about interventions in the landscape network. Such a role of scientific information is enforced by organizing a collaborative planning process. It is suggested that in this way scale crossing connections are developed between individual and community levels as well as between site and landscape levels.

World Cafe: Landscape Conservation Design, Lessons Learned and Looking Forward

Rob Campellone, US FIsh and Wildlife Service

This is part of the Symposium, "Landscape Conservation Design: Applications and Lessons Learned". The Symposium includes a facilitated "World Cafe" approach will be conducted to capture participant's perspectives on opportunities and barriers to the practice of LCD. The World Cafe will consist of 3 rotating breakout group, each facilitated by a member of the organizing committee. Each group will focus on addressing the necessary elements for successful LCD around 1) scientific and technical aspects of LCD, 2) management and policy, and 3) multi-stakeholder collaboration.

Resource experiments connect local scale niche partitioning to community phylogenetics

Ben G. Weinstein. Department of Ecology and Evolution, Stony Brook University. Catherine H. Graham. Department of Ecology and Evolution, Stony Brook University*

Connecting biogeographical patterns with local-scale observation is a challenge in landscape ecology. In neotropical hummingbirds, biogeographic studies show that closely-related species co-occur less frequently than expected when compared to a regional species pool. This pattern may result from limiting similarity and competitive exclusion of closely-related species. However, the role of competition is difficult to infer from biogeographic patterns because competition occurs in local assemblages, and cannot be deduced from regional-scale range overlap. Resource manipulations with Andean Hummingbirds provide an opportunity to test hypotheses of limiting similarity developed at the broad-scale. We tested four mechanisms influencing hummingbird competition using an experimental setup of hummingbird feeders with unequal resource concentration and a novel time lapse video monitoring approach. Competitive behavior was measured as the selectivity of each species at feeders of different sucrose concentrations arranged along an elevation gradient. We modeled selectivity as a function of mass, phylogenetic distance to co-occurring species, and morphological distance to co-occurring species, as well as to the availability of floral resources surrounding the feeder. We simultaneously measured hummingbird visitation to surrounding floral resources to identity species-specific floral resources. The most supported model was increasing selectivity with increasing species-specific available resources. In addition, the choice of resources by hummingbird species was related to its morphology. These results suggest that local competition is mediated through niche partitioning. Closely-related species may be prevented from co-occurring based on limiting similarity along the resource niche axis. This study provides a link between biogeographic patterns and mechanisms learned from local-scale community ecology.

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Forecasting potential bird habitat in LANDIS-II under alternative climate and management scenarios

Brian R. Sturtevant, USDA Forest Service Northern Research Station Rhinelander WI; Brian R. Miranda, USDA Forest Service Northern Research Station Rhinelander WI; Hannah Panci, Natural Resources Research Institute and Department of Biology University of*

Forest managers are increasingly concerned about the potential effects of climate variability and change on forest biodiversity and community resilience. Forests of northern Minnesota harbor some of the richest breeding bird communities in North America that may be vulnerable to climate change. We developed statistical models of bird species abundance as a function of land cover, forest composition, landscape pattern, and climate variables using data from a 24-year avian monitoring program in the Chippewa National Forest, Minnesota. These models were then integrated into a new avian output extension that uses forest projections and inputs from the climate library to output avian response to simulated LANDIS-II scenarios. We applied new output extensions to project avian responses to anthropogenic (climate change, forest management) and natural disturbance factors (succession, insect, wind, fire, and drought). Results are being used to identify both species and habitats at risk from future climate change scenarios. These projections will help enable adaptive management strategies by the Chippewa National forest and other landowners in the surrounding landscape.

Ant biodiversity of conservation grasslands is regulated by processes at multiple temporal and spatial scales

Kaitlin U. Campbell,Department of Biology Miami University and Thomas O. Crist, Department of Biology, Institute for the Environment and Sustainability, Miami University*

Many landowners and conservation groups are converting marginal agricultural land to semi-natural habitats, such as conservation grasslands. These grasslands are imbedded within a matrix of agriculture, urbanization, and semi-natural habitats and are colonized over time by numerous grassland dependent animals. Ants are widespread arthropods that structure above and belowground food webs and interact with other organisms as predators, herbivores, seed dispersers, and mutualists. Ants are also recognized as valuable environmental indicators for management-based monitoring to indicate ecosystem disturbance and recovery. We studied ant communities in 23 conservation grasslands that differed in area, time since planting, plant community, soils, management, and surrounding landscape. The goals of this study were to differentiate the patch and surrounding landscape (500m radius) effects on the grassland ant species composition and diversity. The best model for ant richness was time since planting ($p=0.010$, dev.expl.=28%). Ant communities show turnover from disturbance tolerant species to grassland specialist species. Species respond in different ways to patch variables (especially soil texture) and are also influenced by surrounding landscape. Greater intensive agriculture in the landscape negatively affected both disturbance tolerant and grassland species. Grassland specialists were more abundant in larger grasslands and those surrounded by more grassland, while disturbance tolerant species were significantly favored by increased urbanization. Our results suggest that ant communities are primarily influenced by habitat age, but both soil and surrounding landscape have differential effects on individual species abundances. These findings support a greater use of ants as environmental indicators at the patch and landscape level.

Effects of Biocultural Diversity for Disaster Reductions in Natural Disasters: The Location and Design of Sacred Places

Naoko Fujita, Kyusyu University

The characteristics of forests and green spaces depend on the natural diversity and historical importance of the surrounding area. It is important to understand the process of historical transition with regard to the occurrence of natural disasters in such areas. In this study, we describe the effects of the location and design of sacred places, such as shrines, with consideration of security against natural disasters, and the ecological and biocultural characteristics of the selected site. Shrine forests are protected and managed in near-natural conditions for purposes of religious worship, and many are located in ecologically rich areas. Some shrine forests have been protected for centuries, and many still retain indigenous flora. These forests thus provide ecological benefits, such as the maintenance of water and air quality, providing habitats for wildlife, and functioning as refugia for native plants. It was found that shrines tend to be dispersed in certain areas. 68% of shrines have been built on slopes. To investigate the geographical features and their relationship with ecological resources, a continuous green space was generated by forming a buffer between the spaces of forests that include shrines and the surrounding green space. This analysis showed that the main building located on the downward slope shows either a high green preservation function (19.4% of cases) or a low one (38.9% of cases). It was conjectured that this difference derives from the relationship between the entrance path and the steep inclination. On the other hand, the main building of a Shinto shrine shows an excellent green preservation function when located on a steep upward or downward slope (11.8% of cases). The forests associated with Shinto shrines function as sites of nature worship. Many shrine forests are located in areas considered safe from the effects of natural disasters, and placed under legislative protection by being designated as national or regional monuments of historical value. Shrines have a scattered distribution across the landscape, but are typically associated with specific geographical features such as small hills, springs, streams, and rivers, which are themselves objects of nature worship.

The Effects of Forest Cover on Ecosystem Services Provided by Predatory Ants in Coffee Farms

Natalia Aristizabal, Universidade de SÃ£o Paulo; Jean Paul Metzger, Universidade de SÃ£o Paulo*

Alterations in land use due to forest fragmentation and agricultural expansion can affect ecological processes, such as predation. Changes on forest cover affect composition of ant communities and therefore their ability to provide ecosystem services. Predatory ants contribute to control coffee's economically most influential pest, the coffee borer beetle (CBB). To investigate the relationship between forest cover, ant community composition, and pest control in coffee farms by ants, we conducted exclusion experiments in one of the world's primary regions for coffee production in Southeastern Brazil. We followed coffee fruit development for one year and measured the efficiency of CBB control between branches with and without ants; across ten landscapes varying in native Atlantic Forest cover (10-60%). In three of those landscapes (with ~10%, 30%, 60% of forest cover), we thoroughly collected ants inside the coffee plantations and their adjacent forest fragments to understand the differences in the integrity of ant communities potentially predating on CBB. To better understand the importance of scale in landscape planning in fragmented landscapes, our exclusion experiments were designed at two different spatial scales: a) influence of forest cover in a 2 km, and b) in a 300 m radius. Preliminary results showed differences in b-diversity among landscapes, suggesting a spillover effect influencing ant communities, CBB control, and coffee production. This project is being conducted during Brazil's worst hydric crisis and might provide firsthand, valuable data that can represent a source of information for landscape ecologists, but also for landowners and policy makers.

Effects of landscape-scale changes in freshwater connectivity - Implications for biological communities in lakes and ponds on the arid Columbia Plateau, Washington

Angela Strecker, Portland State University; Jeff Brittain, Portland State University*

Anthropogenic alterations to natural systems can have severe consequences for ecological processes, changing the conditions under which species have adapted and interactions between species. Globally, aquatic habitat has been rapidly and irreversibly altered by damming and irrigation projects. The Columbia Basin Project in arid eastern Washington built six dams and >300 miles of canals for irrigation, flood protection, and power production. An important early ecological study determined that the many small natural lakes and ponds of this region ranged across broad environmental gradients of salinity, seasonality, and productivity, and contained distinct assemblages of zooplankton species. However, hydrological manipulations have changed both abiotic and biotic conditions in waterbodies through varying groundwater levels and altered connectivity via dams and irrigation canals. Thirty-eight lakes and ponds were sampled during the summer of 2012. Abiotic conditions such as salinity and water clarity have changed significantly following hydrologic alterations. Correspondingly, there have been shifts in zooplankton community composition linked to increased aquatic connectivity, with surprisingly high levels of biodiversity in the most connected parts of the freshwater landscape. Quantifying the effects of abiotic and hydrologic changes on aquatic community structure is imperative to improve understanding of how humans alter freshwater ecosystems, particularly in light of the rapid pace of irrigation development on a global scale.

Identifying Habitat Patches and Dispersal Corridors for Endangered Indochinese Tigers

Naparat Suttidate, University of Wisconsin-Madison; Antony J. Lynam, Wildlife Conservation Society; Ronglarp Sukmasuang, Kasetsart University-Thailand; Dusit Ngoprasert, King Mongkut's University of Technology Thonburi-Thailand; Wanlop Chutipong, King Mo*

The endangered Indochinese tiger (Panthera tigris) is restricted to small, fragmented, and isolated populations within human-dominated landscapes. Habitat connectivity is crucial for their long-term survival because their large home ranges require well-connected habitat patches. Our goal was to assess potential habitat connectivity for Indochinese tigers in Thailand, by first modeling tiger habitat, and second, estimating habitat connectivity. We parameterized an ensemble species distribution model based on occurrence data for tigers from camera-trap surveys of seven protected areas in Thailand, with human disturbance and environmental variables, and included biotic interactions with ungulate prey species (wild boar, sambar deer, red muntjac, and gaur) to identify habitat suitability for tigers. We used habitat suitability and dispersal barrier data to estimate dispersal resistance surfaces, and to assess least-cost paths among currently-occupied and potential habitat patches. We employed graph theory to evaluate the relative importance of each potential habitat patch to overall habitat connectivity. Our analysis showed that potential suitable habitats for tigers in Thailand are fragmented and isolated. However, we identified 14 well-connected habitat patches (70 to 578 sq.km.) that could support viable tiger populations. We identified important dispersal corridors connecting existing populations in Thailand's Western Forest Complex. Our results identify important patches and corridors within a fragmented landscape of Thailand that are integral for maintaining overall connectivity among populations, and thus offer an applicable and robust approach for conservation planning for Indochinese tigers and other endangered carnivores.

Parasitism of Endemic Spruce Budworm Populations at Different Spatial Scales

M. Lukas Seehausen, University of Toronto, Faculty of Forestry; Jacques RegniÃ¨re, Natural Resources Canada, Canadian Forest Service; Veronique Martel, Natural Resources Canada, Canadian Forest Service; Sandy M. Smith, University of Toronto, Faculty of F*

Host-parasitoid dynamics are very complex, especially when analyzed at different spatial scales. Complexity increases when different host densities are also taken into account. Spruce budworm

Choristoneura fumiferana (Clemens) (Lepidoptera: Tortricidae) is a good model species to study those complex trophic dynamics. This defoliator of North American conifer forests undergoes periodic outbreaks. One mortality factor playing an important role in spruce budworm outbreak cycles is parasitism. The parasitoid community attacking spruce budworm and their relative importance as mortality factor changes with spruce budworm density. Extensive studies have been done on spruce budworm parasitism at outbreak levels, however, less studies on endemic populations. Ongoing studies on parasitism of endemic spruce budworm populations, especially by the larval parasitoid Tranosema rostrale Brischke (Hymenoptera: Ichneumonidae), give insight in factors influencing parasitism at low host densities and different spatial scales.
At the smallest scale, the success of the parasitoid's attack and development depends on the host itself, e.g. larval instar and direct environment. At tree-level, parasitism rates at different heights in the tree crown can be very variable, depending on the attacking species and further complex factors. At stand-level, experiments show that partial cutting treatments can reduce parasitism of endemic spruce budworm populations. Climate variables such as temperature influence parasitism over large areas. Rearing spruce budworm larvae parasitized by T. rostrale at different temperatures revealed that the parasitoid's survival decreases with increasing temperatures whereas spruce budworm survival is only reduced at extreme temperatures. This result may have important implications in explaining phenology, distribution, and efficacy of T. rostrale as a mortality factor of endemic spruce budworm populations. A better understanding of factors influencing parasitism of endemic spruce budworm populations at different spatial scales will help to understand outbreak cycles and improve its management at the landscape level.

Biodiversity monitoring in agricultural landscapes: Why - What - Where - When?

Felix Herzog, Agroscope, Institute for Sustainability Sciences; Janet Franklin, School of Geographical Sciences and Urban Planning, Arizona State University*

One third of the global land area is under agricultural use and numerous wild species depend on farmland habitat. Many wild species are key to the functioning of agro-ecosystems (e.g. pollination, predators of agricultural pests). Policy makers and farmers need to be aware of the status of farmland biodiversity in order to evaluate conservation goals and management options. Ongoing European and North American monitoring programs related to farmland biodiversity are critically reviewed in the context of recent research findings and future information requirements. We address the selection of indicators (pressure - state - response), scale (plot - farm - landscape), sampling design (random - stratified) and the trade-offs between scientific rigor, stakeholder demands and budget restrictions. Whilst best practices for monitoring species and habitat diversity per se exist, approaches for the monitoring of ecosystem services (and dis-services) still need to be developed. We will summarize the state of the art and formulate recommendations for future research.

Forests, Trees and Food: how forested landscapes contribute to dietary diversity and nutrition

Terry Sunderland, Centre for International Forestry Research

Forests and tree-based agricultural systems contribute directly and indirectly to the livelihoods of an estimated one billion people globally. Wild foods are important for food security and nutrition while trees and forests are vital for their role in the provision of ecosystem services to agriculture. The alarming expansion of large-scale industrial production systems in tropical regions threatens the potential contributions of forests and tree-based agriculture systems to the food security, diets and nutrition of a growing world population. Despite this, the role of forests in supporting human food

security and nutrition remain largely under-researched and understood. With food security and nutrition high on the agenda in many political and scientific spheres, it is crucial to understand the contribution of forests and trees to a food secure and nutrition-sensitive future. This improved understanding will be essential for building on synergies and minimizing trade-offs between biodiversity conservation and sustainable agriculture in order to feed an estimated global population of nine billion people by 2050. Forests, biodiversity and agro-ecology should feature more prominently in political and scientific discourse on agricultural production and the concomitant challenge of sustainable forest management. Greater attention to the direct and indirect benefits of forest in food security, livelihoods and nutrition should enhance local and global efforts to end hunger and improve the nutrition of communities living in forested areas as well as those living in areas removed from forests.

Ecosystem services - Supply, flows and demands in and between landscapes

Benjamin Burkhard, Marion Kruse, Felix Muller; Kiel University*

Major challenges in integrative transdisciplinary ecosystem service assessments are the high complexity of the topic itself, the linkage of ecosystem services to complex adaptive human-environmental systems and the need for universally applicable concepts and methods. Different ecosystem service classification systems (e.g. MEA, TEEB, CICES) and varying understanding of complex ecosystem service supply-benefit delivery chains among scientists have inhibited broad-scale practical applications so far. Therefore, concepts on a) how ecosystems produce services including the different ecosystem service delivery components, b) how to consistently quantify ecosystem service stocks and flows, c) how services relate to each other (trade-offs and synergies) and d) how landscape changes affect future service delivery are needed. Moreover, most of the currently available ecosystem service studies consider ecosystem service supply only whereas ecosystem service demands have not been sufficiently addressed. The integration of societal needs and values for goods and services is mandatory in order to enhance currently applied function-oriented landscape planning approaches and environmental management strategies. This reveals the full application potential of the ecosystem services framework. New concepts, challenges and ideas of ongoing ecosystem service research will be presented and critically discussed.

The influence of surface water network structure, landscape resistance-to-movement and flooding on ecological connectivity across Australia's largest river basin

Robbi Bishop-Taylor, Centre for Ecosystem Science, School of BEES, UNSW Australia; Mirela G Tulbure, Centre for Ecosystem Science, School of BEES, UNSW Australia; Mark Broich, Centre for Ecosystem Science, School of BEES, UNSW Australia*

Landscape-scale research quantifying ecological connectivity is urgently required to maintain the viability of populations in dynamic environments impacted by anthropogenic modification and environmental change. We evaluated how surface water network structure, landscape resistance-to-movement, and flooding affect amphibian habitat connectivity within the Murray-Darling Basin, a highly modified but ecologically significant region of south-eastern Australia. We created circuit theory, Euclidean and least-cost potential connectivity networks for two amphibians with different dispersal abilities, and used graph theory metrics to compare regional- and patch-scale connectivity across a range of flooding scenarios. Circuit theory networks were more connected than Euclidean and least-cost equivalents in floodplain environments, and less connected in highly modified or semi-arid regions. Networks were highly fragmented for both species, with flooding critical for facilitating landscape-scale connectivity. Both formally and informally protected habitats were more likely to form important connectivity â€œhubsâ€ or â€œstepping-stonesâ€ compared to non-protected habitats, and increased in importance with flooding. In the Murray-Darling, habitat network structure and the

landscape matrix affect connectivity in ways which vary spatially and in response to flooding. Our findings highlight the importance of utilising organism-relevant connectivity models which incorporate landscape resistance-to-movement, and incorporating dynamic landscape-scale processes such as flooding when quantifying connectivity to inform conservation.

Who knows best? the role of stakeholder knowledge in land use models

Richard Hewitt, Observatorio para una Cultura del Territorio*

Participatory processes are increasingly used for understanding human-environment interaction problems and for developing common strategies for land resource management. These approaches are particularly important in areas where resources are shared by large groups of stakeholders and yet there is no general agreement about how these resources should be managed. In many such cases, detailed quantitative information about human-environment interaction problems is available to scientific institutions and land managers, but not easily accessible to other stakeholders. Conversely, important contextual information, such as historical evolution of the landscape in the locality or the probable drivers of historic land change is often embedded as informal local community knowledge. Land use models, in which qualitative and quantitative data can be combined at multiple levels and scales, provide an ideal bridge between highly detailed quantitative knowledge available from scientific stakeholders, and informal or unstructured knowledge about dynamics, evolution and change held by other parts of the stakeholder community. Here it is argued that stakeholder information can be incorporated in land use models by engaging stakeholders as model co-developers, and structuring activities, where possible, so as to include their knowledge directly as parameters and variables. A participatory land use model is thus conceived as a cycle of alternating analytical and discursive activities from which useful results may be obtained, but which does not presuppose an optimum or "right answer", or prioritize scientists' knowledge above relevant knowledge held by other actors.

Anthropogenic drivers of landscape change and configuration in the Ganga river catchment in the Indian Himalayan Region

Tanvi Gaur, Guru Gobind Singh Indraprastha University; Ankita Sinha, Wildlife Institute of India; Bhupendra Singh Adhikari, Wildlife Institute of India; Kiranmay Sarma, Guru Gobind Singh Indraprastha University; Ramesh Krishnamurthy, Wildlife Institute of

The River Ganga in the western Himalaya forms the lifeline of the Indian sub-continent, but is also amongst the top ten river systems in the world threatened by human actions. The mountainous section of the river, where it originates, produces much of the water resources and also has huge hydroelectric potential. Due to the construction of multiple dams, the flow regime of the upper Ganges system has been grossly manipulated, influencing the structural and functional patterns of broad taxonomic groups. We studied the effects of anthropogenic activities on the depletion of forest cover in the basin, focusing on patterns of changes in landscape configuration over two decades. We adopted a novel mapping technique amenable for rugged terrain using Remote Sensing and GIS tools and predicted the probability of change in the land cover/land use types across two decades (1993-2003 and 2003-2013) using Morkov and Change Vector Analyses. The landscape configuration has been significantly altered by hydropower development projects in the form of habitats loss and barrier effects to migratory species. There were also perceptible changes in dense forest types towards open forest types across the landscape. Such anthropogenic activities tend to affect the ecological integrity of river ecosystems, compromising habitat quality and the biota through numerous complex pathways. Anthropogenic activities have also modified the riverbank characteristics, facilitating unprecedented calamities in the recent years. These observed pattern and processes in the specific river system compound the

vulnerability of the species and habitats that are already under severe climate change effects and thus, invokes integrated habitat management and climate adaptation strategies.

Establishment of a methodological basis of adaptive - landscape system of agriculture using GIS â€“ technology (on the example of the northern slope of the ILi Alatau Mountains)

Kerimbay N. N., Mamutov ZH. U., Kakimzhanov E. H., Makash K.K., Kerimbay B.S. (Al-Farabi Kazakh National University, Kazakhstan)

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Integrating Water cycle management: building capability, capacity and impact in Education and Business (I-WEB)

Meyer, Burghard (Leipzig University, Germany) & Lundy, Lian (Middlesex University, London)

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Summary of the Symposium

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Can we Detect the Genetic Signals of Range Expansion for the Invasive Red Fox in Australia?

Aaron Adamack, Bernd Gruber, Stephen Sarre - Institute for Applied Ecology, University of Canberra; Oliver Berry, CSIRO Oceans and Atmosphere Flagship*

Theory predicts that expanding populations should exhibit characteristic genetic signals, including decreased genetic diversity with distance from the source population, and departures from equilibrium allele frequencies (i.e. allele surfing). Populations with known range expansion histories provide an opportunity to test expectations, building confidence that unknown demographic histories can also be faithfully reconstructed. We employed a continent-wide sampling regime (~4100 km west-east) encompassing 3192 red foxes (Vulpes vulpes) that were genotyped at 36 microsatellite loci. We tested whether theoretical expectations of the genetic effects of range expansions are met in invasive Australian foxes, which have a well-documented 150-year history in Australia. Small numbers of foxes were introduced to the state of Victoria, in eastern Australia, from the United Kingdom in the mid-1800s. Foxes underwent simultaneous westward and north-eastward range expansions across the continent and now number in the millions. We tested for decreases in genetic diversity with distance from the introduction site and for departures from equilibrium allele frequencies. Fox genetic diversity decreased with distance from Victoria and there was evidence of allele surfing for the westward range expansion. Genetic signals from the contemporaneous north-eastward expansion were less clear with some indications of decreases in genetic diversity, but no evidence of allele surfing. This may be due to foxes having large population sizes and high rates of geneflow across Eastern Australia, whereas the westward expansion traverses marginal desert habitat which limits geneflow. These results indicate that the theoretical expectations for genetic signals of range expansion may not always be met.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

eHabitat+: Modelling habitat functional types in protected areas globally

Javier Martinez-Lopez, Joint Research Centre of the European Commission; Lucy Bastin, Joint Research Centre of the European Commission; Gregoire Dubois, Joint Research Centre of the European Commission*

Protected areas need to be assessed systematically according to biodiversity values and threats so as to support decision making and fund allocation processes. Characterizing protected areas according to their species, ecosystems and threats is therefore required. While species based conservation approaches are most commonly used, assessing natural habitats is also important. eHabitat+, one of the web services supporting the DOPA, the Digital Observatory for Protected Areas, uses a procedure of automatic segmentation of remote sensing data and other environmental variables to extract the main functional ecological features of habitats for any location. This approach allows for the systematic production of key indicators on protected areas that can be compared at the regional level and provides further the means to identify unique ecological areas that are unprotected. With our first results, we will further discuss the advantages and limitations of the method.

Strengthening long-term landscape-level assessments of montane systems with citizen science, historical air photos and climate models

Michelle Jackson, University of British Columbia; Sarah Gergel, University of British Columbia, Kathy Martin, University of British Columbia, Emmeline Topp, University of Padova*

Assessing landscape change in mountainous landscapes is particularly challenging as complex terrain creates inherent heterogeneity and greatly limits access. Aerial photography and observational data from hikers in remote alpine regions can be extremely valuable in increasing the temporal and spatial coverage beyond that of scientific field surveys. Here, we examine a suite of methods adaptable to monitoring changes in heterogeneity, connectivity and abundance of mountain vegetation on Vancouver Island, BC. First, we used high spatial resolution aerial photography from two time periods to document vegetation change and woody plant infilling over recent decades. As some mountain species depend on open or "gappy" conditions, we also examined patterns of wildlife distributions as well as expected future changes in habitat patch sizes and connectivity under future climate scenarios. To predict the current and future distributions of Vancouver Island White-tailed Ptarmigan (Lagopus leucura saxatilis), we used two input datasets (field surveys and opportunistic citizen science observations) and we compared the performance of five statistical models (as well as an ensemble model). Map predictions of potential suitable ptarmigan habitat differed very little between the field survey and citizen science datasets. Number and size of suitable habitat patches were shown to decline under future climates, implying reduced habitat connectivity. Our results are encouraging for the use of aerial photography and citizen science for monitoring montane species and habitats, saving time and expense while simultaneously involving and educating the public. Improved knowledge of montane landscapes is critical as high elevation habitats shrink due to climate change.

MOTIVE - adaptive forest management in several European case studies: Participatory modelling with consideration of uncertainties

Marc Hanewinkel a) and Marcus Lindner b) a) Chair of Forestry Economics and Forest Planning, University of Freiburg, Tennenbacherstr. 4, D-79102 Freiburg, Germany; marc.hanewinkel@ife.uni-freiburg.de b) Sustainability and Climate Change Unit, Europ

The paper presents major results of the large-scale integrated project MOTIVE (models for adaptive forest management under climate change) financed by the European Union within its 7th framework program. Using the example of case studies representing major forest types in Europe, we show how

adaptive management strategies were developed based on novel modelling approaches and integrating important stakeholder groups within a participatory approach. Taking into account the climate scenarios from AR 4 and 5 impacts of climate change on European forests including effects on productivity as well as economics were taken into account. Potential adaptation strategies were classified according to different manager types and uncertainties were included using Bayesian updating and Dempster-Shafer theory of evidence. Perception of Climate Change and the readiness to adapt to and mitigate Climate Change of private forest owners across Europe was assessed using a standardized questionnaire. Adaptive management strategies vary a lot between regions depending on environmental as well as socio-economic circumstances. The papers concludes with a synthesis of the major findings of the project and important research questions that emerged in the follow-up of the project.

Introduction to the Symposium

Prof. Dr. Burghard Meyer, Institute fo Geography, Leipzig University; C. Schneider

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Natural forests and changes in land use and connectivity in the West Carpathians during last two centuries

Hana Skokanova, Silva Tarouca Research Institute; Dusan Adam, Silva Tarouca Research Institute*

Forest remnants with characteristics of naturalness and various dominant tree species (oaks, beeches, firs, spruces) were identified in the Czech part of West Carpathians. Their localization ranges from lowlands (elevations 88-200 m a.s.l.) to mountains (elevations 1000-1600 m a.s.l.). These remnants are nowadays nearly fully covered by forests and left to spontaneous development; however they used to be managed in the past centuries. We assessed land use changes and corresponding processes in a 5km zone around localities of natural forests, and changes in the connectivity of forests (based on MSPA and EC) that occurred during the last two centuries. Forest dominated throughout the studied period and covered more than half of the area. Its area was the smallest in the 1840s and largest in 2000s. Afforestation was pronounced namely between 1870s and 1950s but continued until 2000s. Period 1870s-1950s was also characterized by increased demand for agricultural land which was reflected in the smaller minimal distance of a forest from the nearest agricultural land. On the other hand, the period 1950s-2000s experienced land abandonment (expressed mainly by grassing agricultural land). Anthropogenic pressure reflected by shortening distance between forest patches and construction land was lowest in the 1840s and increased to maximum in the 2000s. This pressure was partly compensated by afforestation of usually steeper slopes. Fragmentation was high in 1870s-1950s and in 2000s. However, overall connectivity of forests increased which was reflected in the increase of core areas as well as connecting elements in the form of bridges and loops.

Barriers to the spread of wildland fire: quantifying the role of past fire disturbance and topography

Lisa Holsinger, Sean Parks, Carol Miller, RMRS Aldo Leopold Wilderness Research Institute*

Fire activity in the western US has increased dramatically in recent decades, and consequently, there is heightened interest in quantifying the ability of wildland fire to act as a barrier to the spread of future fire. Topographic features (e.g., ridge tops and valley bottoms), however, may also act as a barrier to the spread of wildland fire. Although ample anecdotal and theoretical evidence exists suggesting that past wildland fire limits subsequent fire spread, only a few studies have explicitly documented this effect or

the influence of topography - particularly at landscape scales and across varied ecosystems. In four large wilderness areas in the western US, we examined how past wildland fire and topography influenced the progression of subsequent fire. Results indicate that past wildland fire does limit subsequent fire spread. However, this effect is strongest immediately after a fire and decays through time as fuels reaccumulate. Furthermore, the longevity of this effect varies by ecosystem where wildland fire acts as a barrier to subsequent fire spread for shorter periods (~6 years) in warm/dry ecosystems compared to cooler/wetter (~17 years). We also found important differences in topography's influence on fire spread among study areas that was directly related to topographic complexity and the interaction of topography with previous fires. More broadly our study shows that disturbance processes such as wildland fire are influenced by the legacy of previous disturbance events but terrain also plays an important role in shaping disturbance patterns.

Scalable algorithms for analysis of large geospatiotemporal data sets and applications to landscape ecology

Richard Tran Mills, Intel Corporation; Forrest M. Hoffman, Oak Ridge National Laboratory*

The increasing availability of high-resolution geospatiotemporal data sets from sources such as observatory networks, remote sensing platforms, and computational Earth system models has opened new possibilities for knowledge discovery and mining of ecological data sets fused from disparate sources. Traditional algorithms and computing platforms are impractical for the analysis and synthesis of data sets of this size, however, new algorithmic approaches that can effectively utilize the complex memory hierarchies and the extremely high levels of available parallelism in state-of-the-art high-performance computing platforms can enable such analysis. We will examine some of these approaches and their practical application to the analysis of vegetation phenology data sets derived from MODIS NDVI products and ancillary data layers, and speculate on some of the other applications that such scalable analysis methods may enable.

Landscape change correlated with carabid and spider change over a period of 20 years with urbanization in two villages of Yangtse floodplain

Meichun Duan, College of Agricultural Resources and Environmental Sciences, China Agricultural University and French Higher Institute of Agronomic, Agri-Food, Horticultural and Landscape Sciences; Yunhui Liu, College of Agricultural Resources and Environ*

The influence of landscape change on biodiversity has been wildly concerned, but most study investigated this effect at spatial scale rather than temporal scale. In this study, we assessed the relationship between change in the surrounding landscape and the changes in carabid and spider assemblages in the agricultural landscape at the suburb of Qianjiang city under the context of urbanization between 1993 and 2013. Although building area increased from 6.3% to 32% in the overall landscape, alpha diversity of carabid assemblage did not decrease and spider assemblage even increased while species compositions of both groups were significantly changed. The change in carabid composition similarity significantly correlated with change in surrounding landscape composition similarity. The increase of spider alpha diversity in the same plots between two years was strongly correlated with increase in heterogeneity and proportion of grassland (abandoned field covered by wild grass) in the surrounding landscape. Grassland and road in the surrounding landscape could supply suitable habitat and corridor to carabid and spider and significantly explained variance in the temporal change of their species composition. As a long-term agricultural production areas, agricultural intensity have limited effect on surviving carabid and spider species that commonly have high tolerant of disturbance. It was concluded, the alpha diversity of carabid and spider in agricultural landscape could

still be sustained without substantial loss at current level of urbanization and agricultural intensity, but the local alpha diversity and species composition were strongly associated with the changes in their surrounding landscape.

Pushing the paradigm: why ongoing challenges to current thinking are required

Richard Hobbs, University of Western Australia

26 years after the publication of "Spatial Scaling in Ecology", it should seem ridiculous to undertake any sort of ecological research or management without thinking about scale issues. It is a no-brainer that it's important to choose the appropriate scale of investigation to match the question at hand or to ensure that the scale of management interventions matches the problem being tackled and the goal being espoused. And yet, questions of scale, along with many other important considerations, often remain overlooked or tackled ineffectively. At the same time, rapid and ongoing environmental changes are leading an increasing number of ecologists to explore new approaches to fostering better understanding and more effective management of rapidly changing ecological systems. The impacts of land-use change, climate change, invasive species and other factors all have important spatial and temporal characteristics that often operate at multiple interacting scales. Moving from patterns to processes and on to effective modes of intervention remains a key focus and challenge for ecology. While big strides have been made in this endeavour, ongoing development of ideas and approaches is required. Continued questioning of existing paradigms remains a central element of this. Indeed, I will argue that this is perhaps the most important task ecologists can undertake in order to render the science of ecology ready for the task of informing effective management of ecological systems into the future.

Dynamics of parasitoid communities and characteristics of spruce budworm outbreaks in relation to forest composition

Jochen Frund, Integrative Biology, University of Guelph; Kevin S. McCann, Integrative Biology, University of Guelph; Eldon S. Eveleigh, Natural Resources Canada, Atlantic Forestry Centre; Wayne E. MacKinnon, Natural Resources Canada, Atlantic Forestry*

Eastern Spruce Budworm is one of the most notorious insects defoliating fir and spruce trees in forests of North-Eastern North America. Outbreaks occur at long intervals and with extreme magnitude. The role that parasitoids play in budworm outbreaks is still elusive. The complex food web of parasitoids attacking budworm changes over time in relation to outbreak phases. However, the association of different parasitoids with outbreak phases is mostly anecdotal. Most parasitoids of budworm also attack other hosts or may even depend on them, which means that forest composition could influence parasitoid communities and their dynamics. We use a model that differentiates among different types of parasitoids to establish how the parasitoid community and parasitism should change over the course of an outbreak and how this may be influenced by forest composition. We test these predictions with a dataset of intensively sampled host-parasitoid interactions, following the food web from peak to low budworm densities. We further test whether a signature of parasitoid responses to changing budworm density and forest composition can be found in budworm population dynamics over the last two outbreak cycles across the Canadian province New Brunswick. Our results clarify how parasitoids may influence dynamics of budworm outbreaks.

Does landscape diversity influence species fitness in farmland plants?

Audrey Alignier, INRA UR 0980 SAD-Paysage; Sandrine Petit, INRA UMR 1347 Agroecologie; David A. Bohan, INRA UMR 1347 Agroecologie*

In agriculture, landscape management research has proven extremely valuable for explaining species amount, such as how species capture and utilize changed landscape resources to maintain population size and community diversity. What is surprising is the apparent lack of comparable studies on the effects of landscape properties and management on species fitness. Here, we search for "pathological" situations where landscape effects on farmland plant amount mask significantly different effects on fitness. We examined the case of 83 weed species in 256 fields distributed across the UK national scale. Whether at the local scale of the neighborhood or the larger scale of 2 km, we find landscape effects on species amounts indicate correctly the direction of landscape effects on fitness. Only for five species did we find evidence of pathology, where positive effects of landscape on species amount would mask a negative impact on species fitness; a potential extinction debt. Our results would broadly suggest that for the great majority of weed species, landscape management could continue to use, solely, metrics of species amount. However, there is a future research need to understand why there are contrasted fitness responses in the five weed species

Inferring resistance to gene flow among Valley oak (Quercus lobata) populations in California: Is the Central Valley a barrier?

Maryam Gharehaghaji, University of Illinois at Chicago; Emily Minor, University of Illinois at Chicago; Mary Ashley, University of Illinois at Chicago; Saji Abraham, University of Michigan; Walter Koenig, Cornell University*

Valley oak is an ecologically important species in savannas and oak woodlands of California (USA). Over the last several decades, much of its habitat has been converted to farmland, vineyards, and other development. Its distribution forms a horseshoe around the California Central Valley grasslands. While populations around the horseshoe may be connected by gene flow, pollen dispersal across the Central Valley may be limited. We considered land cover and elevation as major landscape variables that facilitate
or resist gene flow and can help explain genetic structure throughout valley oak range. We sampled 270 trees in 12 populations throughout much of the range of valley oak and genotyped each tree at eight microsatellite loci. To understand how landscape characteristics influence functional connectivity, we created a series of resistance surfaces in GIS by assigning different resistance value to land cover type and elevation. For each landscape resistance surface, we measured resistance distance between each population using Circuitscape. Euclidean distances between all pairs were also measured. Genetic distances
between pairs of populations were calculated using two measures, GST and a newer differentiation statistics,
DJOST. We tested for correlations between genetic distances, Euclidian distance and resistance distance using
simple and partial Mantel tests. The results showed that the eight loci were highly variable. We found a significant relation between genetic distances and elevation resistance but not between genetic distances
and Euclidian distance or land cover. Our results highlight the role of elevation in defining landscape resistance to gene flow.

Targeting for diverse ecosystem service outcomes in an agricultural matrix

Emily K. Zimmerman, Iowa State University; Lisa A. Schulte Moore, Iowa State University; John C. Tyndall, Iowa State University*

Row-crop agricultural landscapes are highly productive with respect to the production of provisioning ecosystem services (ES), but neglect to deliver other progressively more demanded regulating and cultural ES. This research investigates opportunities to help state and federal agencies explore options to enhance and diversify ES outcomes obtained from agricultural landscapes. Presently, conservation programs are voluntary, and as a result conservation programs have not been targeted to those fields that contribute disproportionately to enhancing regulating and cultural ES such as water quality. We hypothesize that by targeting parcels that contribute disproportionately to water quality concerns in the watershed and strategically implementing best management practices (BMPs) on those parcels, water quality can be improved while minimizing land-use tradeoffs and increasing ES delivery. We use a two-stage modeling approach in a Central Iowa watershed to examine the concept. Using a new, innovative GIS-based targeted conservation protocol developed by USDA-ARS (the Agricultural Conservation Planning Framework) coupled with the Agricultural Policy/Environmental eXtender (APEX), we assess the effect on water quality from nutrient and sediment losses under current and alternative land management scenarios. Alternative land management scenarios were designed to assess land-use tradeoffs associated with efficient and cost effective ES production at varying levels of strategic adoption of BMPs (i.e., random placement or coordinated placement of BMPs based on fields with highest vulnerability). We predict that relatively large reductions in nutrient and sediment loss at the watershed level will be achieved by coordinated placement of conservation practices and management techniques on relatively few, high-contributing parcels (>10% area).

Measuring past changes of land use intensity to understand present landscape structure and bird diversity distribution of the Eastern Qinghai-Tibetan Plateau

Li Li, Chair of Wildlife Ecology and Management, Albert-Ludwigs-Universitat Freiburg; Matthias Burgi, Research Unit Landscape Dynamics, Swiss Federal Research Institute WSL*

On the Qinghai-Tibetan Plateau the grass-shrub mosaic landscape provided diverse habitats for numerous native bird species. The traditional nomadic pastoralism substantially shaped this patchy structure. However, since 1984 the state launched a set of policies to upgrade pastoral management through livestock and grassland privatizing. The following land use changes greatly modified the past grazing disturbance regime and impacted the spatial distribution of bird communities. In 2014 we investigated ecological consequences of the alpine pasture land use changes in the Nyanpo Yutse region. Firstly, we collected historical data of herd sizes to quantify grazing intensities before and after the privatization. Secondly, we conducted 38 UAV flights to produce high-resolution (10 cm) ortho-images with which we counted anthropogenic elements and calculated landscape heterogeneity under different disturbance regimes. At last we carried out breeding-season bird survey on the mapped pastures and obtained species richness and composition information. Our results showed that the privatization resulted in landscape-scale pastoral mobility decline and local-scale grazing intensification. Increased anthropogenic elements positively correlated with the number of generalist species. Bird richness significantly varied in different habitat configurations and species composition turnovers occurred at both high and low ends of the land use intensity gradient.

Closing Discussion - Collaborative Opportunties

Brian Buma, University of Alaska Southeast, Tara Barrett, US Forest Service, Sari Saunders, BC Forests, Paul Hennon, US Forest Service*

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Forest inventory evaluation for measuring landscape changes

Chao Li, Canadian Forest Service*

Evaluation of forest landscape changes under various disturbances is one of the challenging issues in landscape ecology. A forest inventory with various variables represents the best knowledge and information available for a given forest region, and the changes in forest inventory before and after a disturbance reflect the impact on the forest landscape. As a result, evaluation of the changes in a forest inventory can serve as a quantitative measure of landscape changes. Since wood volume does not always be proportional to wood value, a value-based framework and its implementation, of evaluating forest inventory is developed. This evaluation framework includes both forest products-based monetary and ecosystem services-based non-monetary assessments of landscape changes, thus it can better satisfy the requirements from an ecological and economic perspective. The evaluation is to address a question of what values a forest could have when it is used for different purposes, either conservation or utilization. This forest inventory evaluation can provide a useful tool for forest managers and researchers in assessing the changes in forest landscapes, and thus improving decision-making on the best strategies in managing the forest resources under their jurisdictions.

Impact of anthropogenic disturbance on native and invasive trypanosomes of rodents in forested Uganda

Johanna S. Salzer, Darin S. Carroll, and Thomas R. Gillespie; Emory University and Centers for Disease Control and Prevention

Anthropogenic disturbance is globally associated with extinctions and invasive species introductions. Less understood are the impacts of this disturbance on the parasites harbored by these endangered, extinct, and introduced species. To improve our understanding of the impacts of anthropogenic disturbance on such host-parasite interactions, we investigated an invasive small mammal trypanosome (Trypanosoma lewisi) across a gradient of habitat disturbance in rural forested Uganda. We examined 348 individual small mammals, representing 26 species, which were identified using molecular and morphometric techniques. We screened each individual for the presence of trypanosomes using both microscopy and PCR. We identified 18% of individuals (all from the order Rodentia) to be positive for trypanosomes. Further phylogenetic analyses revealed two trypanosomes circulating-T. lewisi and T. varani. Trypanosoma lewisi was found in seven rodent species both native and invasive, while T. varani was identified in only three native forest species. The lack of T. varani in more disturbed habitats is likely due to the absence or decline of competent hosts and suggests it is a natural parasite of forest dwelling rodents. Our findings provide evidence that anthropogenic disturbance may lead to spillover of an invasive parasite (T. lewisi) harbored by non-native hosts into native species, and lead to local co-extinction of a native parasite, T. varani and associated native forest-dwelling hosts.

Constraints and novel opportunities for increasing fuels treatment and forest resilience in California

Malcolm North, US Forest Service, PSW Research Station, Davis, CA

Many western U.S. forests are in need of fuels reduction using mechanical and/or fire treatments to increase their resilience to predicted increases in wildfire and drought. Compounding this problem is a focus by many public land agencies on fire suppression, which inevitably leads to large 'feral' fires such as the recent Rim and King fires in California. Using the Sierra Nevada as a model system, I examine the current pace and scales of fuels treatments against historic fire levels and assess constraints limiting more extensive treatment. Focusing on the spatial distribution of these constraints suggests that a significant opportunity to increase treatment extent is being missed because of a focus on slowing, containing and suppressing fire. Furthermore, mechanical prescriptions primarily focused on reducing

fuels may not restore forest drought resilience. Of all 155 National Forests embarking on a new round of forest planning, three of the first forests, the 'early adopters', are in the southern Sierra Nevada. These closely watched initial plans propose some novel approaches to increasing pace and scale and modifying thinning objectives.

QUICKScan: a participatory approach to map ecosystem services and develop hands-on knowledge

Peter Verweij, Marta Perez-Soba, Theo van der Sluis, Michiel van Eupen, Manuel Winograd - Alterra Wageningen UR*

Mapping and assessment of ecosystems and their services is an essential part of the EU Biodiversity Strategy to 2020, and a necessary condition to bring the concepts of natural capital and ecosystem services into practice. Knowing where ecosystem services are supplied and assessing their magnitude are essential to inform social and economic valuation as a basis for rational spatial planning and sustainable development processes and decisions. As part of this EU strategy, the QUICKScan approach has been selected by The Directorate-General for the Environment as a tool to train EU Member States on ecosystem services mapping through hands on workshops with policy makers, technical experts and GIS experts. QUICKScan is a participatory method supported by a specific software tool to link expert's knowledge and stakeholder interests to spatial and statistical data. An iterative approach is applied by starting with simple models and adding progressively complexity. The successive iterations are used to improve the quality of the maps. The tool allows to assess the differences between the maps produced. QUICKScan has proved to provide relevant results in 2-4 hour sessions and it is easier to use than traditional GIS tools. It makes it possible to do an ecosystem service assessment without complex, time consuming and expensive modelling, and to communicate transparently the results. An interactive demonstration showing how the QUICKScan develops iteratively ecosystem maps will be given.

Biodiversity conservation in Brazilian coffee farms: impacts of certification

Elisa Hardt, Federal University of Sao Paulo - Department of Biological Sciences; Edoardo Borgomeo, University of Oxford - Environmental Change Institute; Rozely F. dos Santos, University of Sao Paulo - Department of Ecology; Luis Fernando G. Pinto, Ins*

Socio-environmental certification aims to contribute to biodiversity conservation in agriculture using evaluation criteria to promote the conservation of natural vegetation and landscape connectivity. This contribution was evaluated to deforestation control, habitat protection and regeneration, and landscape connectivity. The analysis compared changes after a decade (2002-2011), using as a reference the surrounding landscape and a control group of non-certified farms. We used CONEFOR to measure the functional connectivity for two species of terrestrial mammals with contrasting dispersal capacities and habitat requirements: Priodontes maximus and Marmosops incanus. Compared to reference groups, certified farms already had a better profile of conservation at the beginning of the certification process. Probably the reason why the changes in the last decade have been subtle. Even so, changes on certified farms seem to be different from control farms in terms of the extent of vegetation cover and functional connectivity for the two studied species, especially for P. maximus. Despite the subtle changes, compared to their surrounding landscapes, the certified farms increased the local conservation by deforestation control and increase in forest regeneration, having a important role to control conversion of new natural areas in agricultural lands, especially in Brazilian Cerrado.

The vegetative landscape and resource utilization of two Japanese shrines found in historical documents of forest management from the 17th to 18th centuries

Ayumi Imanishi, Kindai University; Junichi Imanishi, Kyoto University*

In Japan, the public tends to believe that shrine forests are remnant of primary vegetation of a region. However, recent studies show that several shrine forests in Kansai region were once dominated by pine trees, which is a component of secondary forests. We studied the relationship between vegetative landscape and resource utilization of two shrines (Kamomioya Shrine and Kamo-wake-ikazuchi Shrine) from the 17th to 18th centuries. Investigation of old drawings and historical documents on forest management revealed that there was a mixed forest with pine trees and broadleaved trees and cedar trees which existed around the shrine pavilions at Kamomioya Shrine. There were pine, cedar, cypress and broad-leaved trees at the precinct of Kamo-wake-ikazuchi Shrine and that the neighboring shrine mountains were dominated by pine trees. Those vegetative landascapes were different from the present one that is closer to climax vegetation of the region. The historical documents demonstrated that clearings of dead and damaged trees and underbrush were common management for the forests of Kamomioya and Kamo-wake-ikazuchi Shrines, and indicated that pine trees were naturally regenerated after them. The collected woods were utilized in various forms such as firewood and materials of bridges by shrine families. The right of forest resource utilization including loggings was bid and illegal collection of forest resources at the shrine forests was prohibited. These results indicated that the shrine forests were protected not only as sanctuaries but also utilized as properties to support continued existence of shrines.

Spatial relationships of plant functional traits and Ecosystem functions from MODIS for Scotland

Alessandro Gimona; Laura Poggio; Enrico Simonetti; Rob Brooker; Ruth Mitchell; Robin Pakeman The James Hutton Institute - Aberdeen

The link between ecosystem functions and their biophysical underpinning (including biodiversity) is a major focus at present for both applied and fundamental research. This work focuses on exploring the relationship between ecosystem function described by MODIS satellite data and plant functional traits. Spectral information recorded by MODIS is influenced by phenology, variations in morphological and biochemical properties of the species assemblage within each pixel and also by local environmental factors such as soil properties or water stress that determine environmental suitability for each species. The functional diversity of plants in each pixel is calculated by combining distributional and species trait data and related to a time series of MODIS images across 11 years (2002-2011).The results show a clear relationship between MODIS indices, terrain, soil and the trait scores attributed to the pixels based on their species composition indicating that MODIS is a good predictor of some plant functional traits and that, conversely, plant functional traits are related to the pattern of ecosystem function emerging over large areas.

Effect of climate and land use change on soil organic carbon in Beijing, China

Weilin Huang, Beijing Normal University; Yuhong Tian, Beijing Normal University*

The global pedosphere is a huge carbon pool, a slight fluctuation in the soil organic carbon may result in great changes inÂ concentrations of globalÂ carbon dioxide, thus doing research into soil organic carbon has significant meaning to the global change research. By using CENTURY model, on the basis of the meteorological data and land use data, this study simulated the spatial and temporal dynamic of soil organic carbon of the study area in Beijing. The measured data was used to compare with the results of the simulation to make a verification that the model had been adjusted and run in a steady state. Combined the results with statistical analysis and other methods, this study analysed the effect on soil organic carbon caused by the change of climate and land use, and predicted the variation trend of the

soil organic carbon in the future which might contribute to the global change research related to carbon pool.

Critical Transitions, Resilience, and Innovation in Hybrid Ecosystems

Marina Alberti, Professor, Department of Urban Design and Planning, University of Washington

Cities face unprecedented challenges. Global environmental change is placing increasing pressure on ecosystem functions and their ability to support human and ecological wellbeing. Urbanization is a key driver of global-scale phenomena such as climate and land cover change that are threatening ecosystem's capacity to deliver essential ecological services (e.g., food production, carbon sequestration, and the provision of clean water). Furthermore, at current rates of urban growth, expected global land cover change will result in significant loss of habitats in key biodiversity hotspots. Urban regions are also the place where the majority of the human population will face the potential consequences of expected irreversible changes in climatic, hydrological, and ecological regimes such as flooding, droughts, and sea level rises. At the core of the challenge cities face is the inevitable uncertainty of dynamic coupled human-natural systems. How can they navigate through such uncertainty and make robust decisions to ensure human and ecological wellbeing over the long term? In this presentation I review emerging hypotheses of key properties of coupled human-natural systems that predict their resilience and enhance their adaptive capacity and innovation. I build on examples of coastal cities to discuss five properties: diversity, modularity, cross-scale interaction, early warning, and self-organization. I then use hypothetical scenarios to advance the hypothesis that urbanizing regions are hybrid ecosystems and that it is their hybrid nature and cross-scale interactions that make them unstable and unpredictable but also capable to innovate.

Linking innovative technologies for a multidimensional integrated spatial development (INTECRE)

*Christine Furst *; Susanne Frank, University of Bonn, Center for Development Research (ZEF)*

An important aspect in sustainable development is the integration of cross-scale, cross-boundary and inter-cultural demands to ensure that key ecological processes are supported, while different legal frames need to be respected. Failures in successful cross-boundary planning policies in sustainable use of natural resources and infrastructural development lead to a severe decrease of regulatory and provisioning services of ecosystems. Missing harmonization in resource exploitation and use of land threatens furthermore the economic success at local, regional and national level. With the project INTECRE, we intend to build a science-policy-practice network on standards and requests for technological solutions that support spatial planning and help to better consider ecological-economic implications in cross-boundary planning decisions. A prerequisite is the availability and use of innovative technologies to support cross-boundary consensus building. The requirements for such technologies lie in the difficulty to assess complex ecological and economic effects of planning strategies confronted to differing legal frames, socio-cultural environments and economic power. We intend to perform an in-depth analysis of existing planning mechanism and support tools regarding their already given ability to provide guidance in complex decision situations. We work on recommendations how to best make use and / or combine appropriate tools along decision processes. Finally, we intend to form a long-lasting partnership that collaborates on the further development of highly performant tools or methodological frameworks and provides consultation to decision makers on their optimal use.

Spatio-temporal analysis is the new frontier in ecological studies

Marie-Josee Fortin, Department of Ecology and Evolutionary Biology, University of Toronto, Canada; Santiago Saura, Departamento de Sistemas y Recursos Naturales, Universidad Politecnica de Madrid, Spain*

To understand how processes shape ecological patterns, ecologists need to move beyond the spatial analyses of snapshot data to the spatio-temporal analysis of spatio-temporal data. Hence ecologists will be able to address novel ecological hypotheses such as how species persistence or range expansion is influenced by the spatio-temporal connectivity of habitat patches. Supporting decision making in conservation necessitates then the determination of the relative contribution of each patch, or group of patches, to the maintenance of spatio-temporal connectivity. Such objective requires computing network metrics and performing removal experiments to assess the patch importance of each patch or group of patches. Fragmented and changing landscapes can include however a very large number of patches, possible combinations of patch removals, and potential patch changes making the spatio-temporal connectivity computation of thousands of patches a NP-complete problem. A way around such concrete computational limit is to focus on species traits and perform functional connectivity assessments to limit the spatio-temporal connectivity search based on species dispersal ability and temporal persistence of populations when isolated. Using forest landscape data, we introduce how spatio-temporal connectivity can be computed and how patch and link importance network metrics that capture the spatial and temporal dimensions in ecological networks.

The metabolic role of none urbanized areas (NUAs) in peri-urban metropolitan contexts

Daniele La Rosa, Department Civil Engineering and Architecture, University of Catania, Italy*

Processes of urban development threaten contemporary metropolitan contexts and lead to an overall decreasing of environmental quality and general fragmentation of agricultural and (semi) natural landscapes. As a result of these processes the number of Non Urbanized Areas present in urban contexts is dramatically decreasing. These areas include cultivated land, abandoned farmlands, grassland, woods and shrubs that are often located at the peri-urban cities' fringes. Among these areas, farmlands and other forms of urban and peri-urban agriculture provide all three major categories of Ecosystem Services, provisioning, regulating and cultural services. Landscape metabolism can be a proper concept for characterization the processes of energy and material transformation occurring in a landscape. Particularly, in human-dominated contexts, such as metropolitan areas, it can be a useful tool to understand mismatches the societal uses of the land/energy and their impact on landscape patterns of Non-Urbanized Areas. This paper presents a first evaluation of the relation between Non-Urbanised Areas and socio-metabolic fluxes of energy and mass occurring in these areas. The evaluation is performed by spatially comparing high-resolution land-use map and socio-economical maps derived by Census Data, along three urban-rural transects of a high density urban context, namely the metropolitan area of Catania (south Italy).

Landscape degradation in Germany and Eastern Poland - Evaluating traditional and modernized agricultural loess regions

Christian Schneider, Jurgen Heinrich -Leipzig University, Institute of Geography

This study analyzes the impact of different farming systems on degradation dynamics in European loess landscapes. The analyses are based on geochemical soil properties, geomorphological indicators, landscape metrics, and the High Nature Value Farmland (HNV) indicator. The German Middle Saxonian Loess Region represents loess landscapes whose ecological functions were shaped by land consolidation measures resulting in large-scale, high-input farming systems. The Polish Proszowice Plateau is still

dominated by more traditional, small-scale agriculture. The research areas were analyzed on different scales combining GIS, field, and laboratory methods on pedological and botanical aspects. A digital terrain classification was used to identify representative catchment basins for detailed pedological studies which were focused on soil properties that responded to soil management within several years. Both landscapes show severe but different degradation marks shaped by agricultural practices. In Germany, a decline in landscape structures caused a decrease of HNV farmland. Large-scale plots with long, continuous slopes are the main cause for erosion. But denudation, transport, and accumulation effects are often mechanically managed at one field. It resulted in a homogenization of soil patterns. Additional causes for degradation processes are high inputs of fertilizers and herbicides. In Poland, small plots and fragmented ownership make it difficult to manage soil erosion. Numerous linear landscape elements function as protective barriers but also cause run-off concentration. Thus, surface water becomes erosive even on short slopes resulting in diversified geomorphology and heterogeneous soil patterns. But landscape elements also counteract landscape degradation by supporting the preservation of HNV farmland.

Landscape features as a basis for ecosystem services assessment. The case of tourism in post-glacial landscape (Great Masurian Lakes, Poland)

Sylwia Kulczyk, University of Warsaw, Faculty of Geography and Regional Studies; Malgorzata Kowalczyk, Institute of Spatial Management and Housing, Warsaw; Edyta Wozniak, Space Research Centre, Polish Academy of Sciences; Marta Derek, University of Warsa*

Nature is essential to tourism. It not only enables different activities, but also influences visitors' well-being. Consequently, tourism and recreation are recognized as ecosystem (landscape) services. Land cover, relief and hydrography are commonly considered as principal to tourism. However, little is known about how the diversity of landscape characteristics influence the overall value of it's services to tourism. The problem is important as it allows better tourism planning and management. The objectives of the presentation are: i) to discuss the problem of implementing the ecosystem services concept in tourism research, and ii) to assess importance of different landscape features to tourism in post-glacial landscape of Great Masurian Lakes in Poland. The proposed method combines some of well-established tools. First, field observation was conducted to identify the most popular outdoor activities in a post-glacial landscape. A total number of 5 warm-season terrestrial (such as biking, horseback riding, etc.) and 7 water-based activities (e.g. sailing, kayaking) were taken into account. Landscape characteristics essential for each activity were listed. Then, Analytic Hierarchy Process was implemented. It helped to build a hierarchy of all landscape characteristics which were analyzed. Finally, the matrix analysis of significance (non-crucial, moderately-crucial, crucial) and frequency (rare, frequent, common) of variables was constructed. The results showed that landscape characteristics needed for different water-based activities are more diversified then when terrestrial activities are considered. Such features as land cover type and water depth are of multiuse character, whereas other (eg. water clarity) could be crucial, but also of exclusive use.

Interacting Effects of Wildfire Disturbance and Forest Species Diversity on an Invasive Plant Pathogen

Devon A Gaydos, North Carolina State University; Ross K. Meentemeyer, North Carolina State University; Whalen W. Dillon, North Carolina State University*

One complex challenge facing disease ecology today is how to quantify the relationship between infectious disease dynamics and biodiversity. The "disease-diversity hypothesis" postulates that biodiversity can influence the disease risk of a generalist pathogen by one of two mechanisms: (1) a dilution effect where risk is reduced with increasing diversity due to the reduced competency of

alternative hosts (2) an amplification effect where risk is greater with higher biodiversity due to the pathogen's wide host range. Theoretical and empirical evidence point toward there being a dilution effect, however the challenge is further complicated when you add abiotic disturbances into the mix. Here, we used a geospatial analytics approach to examine the complex interactions between an abiotic disturbance, biodiversity, and the disease prevalence of an exotic, infectious pathogen, Phytophthora ramorum, in the Big Sur ecoregion of California. A previous study conducted in Big Sur found evidence pointing towards a dilution effect, even when accounting for the effects of host density. Shortly after this study was conducted, wildfires burned roughly half of our long term monitoring plots. Using field data collected over an 8 year period, spanning both pre- and post-fire, we used a landscape epidemiological approach to assess the complex relationships between the disease, the disturbance, and the biodiversity at multiple scales.

Implication of future land cover change on the brown bear habitat suitability in the northern part of the Carpathians

Katarzyna Ostapowicz1, Elzbieta Ziolkowska1, Carlos Bautista Leon2, Teresa Berezowska-Cnota2, Tobias Kuemmerle3, Volker C. Radeloff4, Nuria Selva2 1 Department of GIS, Cartography and Remote Sensing, Institute of Geography and Spatial Management, Jagie

Large carnivores and herbivores often require large, undisturbed habitats, and can become in conï¬‚ict with people and land use, which makes their conservation in human-dominated landscapes highly challenging. Distribution range and population size of brown bear (Ursus arctos) populations in Europe have changed significantly in the past and the long-term persistence of the species is threatened by habitat loss and fragmentation due to infrastructure development. In this study, we aim to model future land cover change and their influence on the brown bear habitat suitability in the Carpathians, one of the largest strongholds of brown bears in Europe and where this population has been fragmented since the early 20th century. In particular, we focus on possible changes in brown bear habitat fragmentation caused by road networks development and growth of built-up areas in the study region. We use the Dyna-CLUE land use modelling framework to create land cover change scenarios up to year 2065, and maximum entropy modelling approach to assess changes in brown bear habitat suitability. We assume that the future increase of infrastructure density will affect significantly an increase of brown brear habitat fragmentation in the study region. We gratefully acknowledge support by the National Science Centre [project 2011/03/D/ST10/05568]

Mapping the ecosystem service Recreation at various spatial scales

Felix Kienast, Swiss Federal Research Institute WSL; Barbara Degenhardt, University of Applied Sciences and Arts Northwestern Switzerland FHNW, Matthias Buchecker, Swiss Federal Research Institute WSL

Green space in and around cities is considered an important landscape resource for the cultural ecosystem service recreation which is listed as "Physical and experiential interactions" in the CICES catalog of ecosystem services. Recreation is probably one of the few cultural services where mapping is most advanced. It is dependent on the quality of the physical space, and equally important on people's perceptions and the meanings of places. Attempts to map the service recreation at the local scale are, e.g., reported by Willemen et al. (2012) or Kienast et al. (2012). In the latter, recreation behavior of people living in five Swiss towns with 10,000 - 100,000 inhabitants was analyzed using questionnaires. The focus was on the nearby recreation areas--areas within 10 to 15 minute walking or driving distance. Residents indicated (1) their outdoor activities, (2) time spent, (3) type of transportation used, (4) preference for given landscape properties, and (5) preferred locations on maps with a cell size of 1km^2. We applied statistical models to relate reported presence/absence of people in 1km^2 cells to the

characteristics of the landscape in the same cells. The surveys revealed that cultural backgrounds " approximated by language" do not significantly change the recreation behavior of people, and that the landscape characteristics found to significantly influence nearby recreation in the model include distance to residence, open water, forests, summits with an overview, and avoidance of major roads. Based on these relationships, the supply of the ecosystem service nearby recreationÂ was estimated for the whole of Switzerland.

Hierarchical scaling of landscape connectivity and spatial structure: network modularity and beyond

Robert J. Fletcher, Jr., Department of Wildlife Ecology and Conservation, University of Florida Denis Valle, School of Forest Resources and Conservation, University of Florida

Biologists have long emphasized the profound importance of spatial scale for ecology, evolution, and conservation. Nonetheless, objectively identifying critical scales has proven challenging. Here we evaluate new techniques from physics, social sciences, and statistics that aim to identify unknown scales in networks to address the problem of functional connectivity, where movement of organisms occurs among resource patches. We review and contrast the benefits and limitations of using network modularity, stochastic block models and their extensions, and latent dirichlet models for identifying meso-scales in connectivity. Network modularity has been proposed as a powerful approach for revealing scaling in movement on networks, but this approach is limited in predicting such structure in space or time. Stochastic block models from the social sciences provide a statistical framework for predicting latent groups or structure, when linkages are the sampling unit of interest. In contrast, latent dirchelet models, originally developed for text mining, can provide a statistical framework for predicting connectivity when the individual, rather than the link, is the sampling unit of interest. We illustrate these models with movement and gene flow data on two species that vary widely in dispersal ability. We argue that latent structure in connectivity is likely common in populations, and that such structure can alter conclusions on connectivity and its importance. We expect that these new approaches will provide a powerful means of identifying fundamental scales for biology and for conservation strategies aimed at recovering imperiled species.

Panel Discussion

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Developing windthrow risk model for plantation management strategy under climate change

Kosuke Nakagawa,Graduate school of Agriculture Hokkaido University; Junko Morimoto, Agriculture Hokkaido University; Yasuto Furukawa, Agriculture Hokkaido University; Yoshio Mishima, National Institute for Environ*

Windthrow disturbances, which regulate dynamics and diversity in forest ecosystems, are one of the key ecological processes in monsoon Asia. However, current rapid landuse conversions and climate change may significantly transform the wind disturbance regime. In Japan, much of natural forest was converted to even-aged plantations during the "Aforestation Policy" in the 1960's. In addition, current inadequate forest management, owing to declining forestry, will enhance vulnerability to natural disturbances, including strong winds. The goal of this study was to provide a precise, practical risk model to explain the risk factors for and predict the occurrence of windthrow. We aim to develop a windthrow risk model using two different approaches: the generalized linear mixed model (GLMM) and machine learning (ML; e.g. random forest and boosted regression trees). We chose 4 plantation and 4 natural forest sites,

which had been damaged by the same typhoon in September 2004, in Hokkaido, Japan. Windthrow patches, forest factors(stand age, H/D ratios, stem density, stem density of broadleaf trees), topographic factors (elevation, slope, TOPEX; topographic exposure, TPI; topographic position index) and climate factors (maximum wind speeds, duration time of strong winds, mode of wind speeds) were input into a geographic information systems (GIS) database, and the GLMM and the ML models were applied. We will investigate the risk factors at play in natural forests and plantations, and we will discuss how to apply these models to windthrow risk assessment and propose forest planning and management strategies to reduce windthrow.

The importance of habitat heterogeneity in understanding the effect of forest management practices on salamanders.

Lauren H Blyth, School of Environment and Natural Resources, The Ohio State University; Todd S Hutchinson, USDA Forest Service, Northern Research Station; Stephen N. Matthews, School of Environment and Natural Resources, The Ohio State University*

Forest salamander abundances decline after disturbance when measured at treatment or stand level. However, salamanders have small home ranges on the scale of within-treatment variability created by background conditions and management. Salamander community data was collected from 2013-2014 in the unglaciated Appalachian plateau of Ohio, USA after thirteen years of treatments designed to mimic natural heterogeneous disturbance. Treatment included prescribed fire, which affects stands unevenly due to differences in fire intensity. Discriminant function and redundancy analyses showed that sites did not group by treatment or replicate and different salamander species associated with the range of available microhabitats. Habitat relationships of the two most abundant species were examined using occupancy analyses. The upland breeder, Plethodon cinereus (eastern red-backed salamander), associated with mesic habitats. In contrast, Ambystoma opacum (marbled salamander), a pool-breeding species, associated with increased oak composition in the overstory. One species or group is not sufficient as an indicator representing all salamanders as silviculture may differentially impact species with different habitat associations. This study showed that salamander biodiversity is maintained in oak forests managed with disturbance where within-site heterogeneity provides habitat for a range of species. Thus, salamanders are likely responding at a finer scale than is often considered.

Parallel Spatial Simulation of Urban Agglomeration in North Carolina, USA

Wenwu Tang, Center for Applied GIScience and Department of Geography and Earth Sciences, University of North Carolina at Charlotte; Wenpeng Feng, Center for Applied GIScience and Department of Geography and Earth Sciences, University of North Carolina a*

Urbanization plays an important role in modifying and regulating landscape characteristics and functions. Spatial simulation, represented by cellular automata and agent-based models, has been increasingly used to study interactions between urbanization and landscape patterns in a decentralized manner. The spatial simulation approach is of great help for representing and understanding the space-time trajectory of urban development and associated complexity. However, spatial simulation of urban development has posted a considerable computational challenge for the study of urban agglomerations, which often cover a large spatial extent. Cyber-enabled parallel computing has been identified as an alternative to resolve this computational challenge. In this study, we present a parallel computing approach to support the spatial simulation of urban agglomerations in North Carolina, USA. We focus our discussion on the design of parallel spatial strategies that allow for efficiently harnessing high-performance computing capability for the large-scale modeling of polycentric urban development. We calibrate and validate the simulation model using empirical data in our study area. This parallel

simulation approach offers us an ability to investigate the space-time complexity of urban agglomeration phenomena, which otherwise cannot be possible using desktop computing. More importantly, this parallel simulation approach provides substantial support for the study of the multi-scale impact of urban agglomerations on the sustainability of regional landscape.

Landscape Ecology in Aoteraoa-New Zealand: Origins, trends, challenges and opportunities.

Simon Swaffield, Lincoln University. Colin Meurk, LandcareResearch Ltd.*

New Zealand has a highly endemic ecology, developed separately from and vulnerable to invasions from land mammals and their co-adapted ecosystems. It is the last such land mass on earth to be occupied by humans. Colonisation by Polynesian migrants around 1300 then Europeans in the 1800's resulted in dramatic ecological transformations by fire, forest clearance, hunting, introduced rats and dogs, grazing mammals, invasive pests and weeds, industrial technology and agricultural intensification. Today 2/3 of NZ land area is predominantly exotic, while even in more natural areas, biodiversity is under pressure from introduced organisms. Based on literature review and key informants, we investigate how landscape ecology has been informed by and responded to the distinctive context of Aotearoa-New Zealand. Early landscape ecologists focused upon understanding plant communities and their role in pastoral agriculture. Characterisation of Ecological Districts and Regions in the 1980s stimulated two decades of increasing awareness of spatial dynamics, representativeness and indigenous knowledge. Contemporary landscape ecological science is focused on conservation biology, ecological restoration in rural and urban contexts; and synergies with cultural heritage. Immediate challenges are the post-colonial legacy of pest invasion, reconciliation of indigenous knowledge with modern and citizen science, ideological tensions over landscape futures, and the need for re-integration of nature, culture and agri-business structures and dynamics. Landscape ecology can contribute to environmental and economic resilience in NZ production and urban ecosystems. However it remains marginalised from mainstream policy and research funding, and progress often depends upon small scale voluntary action.

Does Green Infrastructure need Biodiversity?

Michael Strohbach, Dagmar Haase; Humboldt University Berlin*

Green infrastructure (GI) can be understood as a network of natural, semi-natural and designed green spaces, providing ecosystem services to people and habitat for wildlife. While it is increasingly understood that GI can function similarly to gray infrastructure, the importance of biodiversity for the functioning of green infrastructure is much less understood. Are diverse and native green infrastructure elements better service providers than elements composed of novel communities? Does higher species richness provide for higher resilience? In this talk we review the role of biodiversity in well-functioning Green Infrastructure, focusing on cities.

Predicting the hydrologic response of an urbanizing watershed to future impervious surface growth using an integrated modeling approach

Michael G. Sunde, University of Missouri-Forestry; Hong S. He, University of Missouri-Forestry; Jason A. Hubbart, University of Missouri-Forestry; Anthony Spicci, Missouri Department of Conservation

Hinkson Creek Watershed (HCW) is an urbanizing watershed in central Missouri comprising a 23180 ha area. Approximately 59% of Columbia, a city of 113,225 residents, is situated within HCW. Urban growth in HCW has been rapid-between 2000 and 2012, the population of Columbia increased by 30.6% and, between 1980 and 2011, total impervious surface cover in HCW increased from 5.9% to about 10.9%. Fast-paced growth in the area is ongoing and HCW has been the focus of management efforts to address

the impact of urban development on the stream. To assess the hydrologic response of HCW to future impervious surface growth, the Imperviousness Change Analysis Tool (I-CAT), a GIS-based urban growth model capable of simulating pixel-level percentage imperviousness, was used to simulate impervious surface growth in HCW from 2011 to 2031. Results derived from I-CAT were then coupled with the Soil Water Assessment Tool (SWAT), a semi-distributed hydrologic model. The modeling results suggested that, at the current rate of growth, the amount of impervious surface cover in HCW could increase to 24009.2 ha by 2021 and to 24760.9 ha by 2031, and that streamflow volume in Hinkson Creek could increase by about 6.7% under 2021 imperviousness conditions, and by about 15.2% under 2031 imperviousness conditions. The results for the 2021 and 2031 impervious cover conditions also indicated that average annual surface runoff could increase by 6.7% and 14.5%, average baseflow could increase by 6.6% and 17.7%, and average annual evapotranspiration could decrease by 4.5% and 10.2% respectively.

Planning pathways to resilient landscapes in collaborative platforms

Adrienne Gret-Regamey, Sibyl Hanna Brunner*

Mountain cultural landscapes provide a range of crucial ecosystem services both to people living in and outside mountains. Since these socio-ecological systems are highly fragile towards changes and have slow recovery times, local and regional development strategies need to take into account thresholds of socio-economic, political and ecological changes that result in irreversible losses of ecosystem services. Backcasting - as an opposite to traditional forecasting - has been advocated as an approach for assessing pathways and tipping-points in strategic planning. In this contribution, we will present a backcasting-based collaborative decision-support tool, which allows exploring dynamics and thresholds of land use transitions and related ecosystem services changes. The backcasting approach is based on an economic land allocation model extended by ecosystem services and embedded in an interactive decision-support tool. The dashboard of the tool includes 3D visualizations of the land use changes, information about changes in ecosystem services and socio-economic parameters, as well as narratives describing the different management strategies. The implementation of the decision tool in practice confirmed the importance of providing information about major ecosystem services trade-offs over space and time for supporting decision-makers in face of global changes mountains are facing.

Cultural heritage recorded in the relief of the landscape abandoned by people - old shapes, new functions

Andrzej Affek, Institute of Geography and Spatial Organization Polish Academy of Sciences

The problem of formation and persistence of man-made forms of land relief and their impact on the landscape has drawn researchers attention for a long time. The persistence of man-made forms of relief in mountainous areas heavily transformed and used by man through centuries and now abandoned as a result of post-war forced displacement gain particular interest, especially among researchers from Central Europe. Agricultural terraces, roads, balks, ditches and ponds no longer serve the purposes for which they were created, but are still more or less evident in the landscape. The aim of the study was to determine the historical and current function of chosen man-made forms of relief in the landscape abandoned by people. The identification of elements of cultural heritage recorded in the terrain and hidden under tree canopy was carried out by means of airborne laser scanning (ALS), the technology capable of providing the first detailed spatial information about the shape of the land surface under forests. Two main hypotheses were verified: 1) Man-made forms of relief once performing a specific function for the human being last in the landscape and acquire new ecological functions after land abandonment. 2) Elements of cultural heritage recorded in the terrain are better preserved under tree

canopy than in open space. The study area includes 3 former villages located in the Polish Eastern Carpathians, which ceased to exist in the mid-forties of the twentieth century and now are covered by forest.

Urban land teleconnections and urbanity - two new approaches to explore current global urbanization and its impact on sustainability

Dagmar Haase Humboldt Universitat zu Berlin and Helmholtz Centre for Environmental Research - UFZ

This paper discusses two new concepts to approach current processes, patterns and impacts of global urbanization that have been developed recently by two groups of researchers of the Global Land Project (GLP). Both concepts attempt to overcome existing limitations of urbanization theory and models by expanding the scale of and alternatively defining "the urban": The first concept deals with urban land teleconnections as a conceptual framework that explicitly links urban land changes to underlying demographic and urbanization dynamics and thus uncovers the implicit assumptions about path dependency and sequential land changes that underlie current conceptualizations of urban land transitions. Urban land teleconnections are distal flows and connections of people, economic and ecosystem goods and services. The concept can illustrate how three key themes that are currently addressed separately in the urban sustainability and land change literatures can lead to incorrect conclusions and misleading results when they are not examined jointly: the traditional system of land classification that is based on discrete categories and reinforces the false idea of a rural-urban dichotomy; the spatial quantification of land change that is based on place-based relationships, ignoring the connections between distant places, especially between urban functions and rural land uses. The second concept, linked to urban land teleconnections, proposes a conceptualization of land that measures and analyzes urbanity, the urbanness of places and the economic activity and population characteristics of the land. Urbanity is defined by how people support themselves through various livelihoods, the material culture and patterns of consumption representing different lifestyles, their spatial connectivity, and how they identify with the places they reside and rely upon. The magnitude and qualities of livelihoods, lifestyles, connectivity, and place create the degree of urbanness of intertwined human experiences and land configurations define a continuum of urbanity across the globe, not defined by administrative boundaries of cities, but by the activities and functions that occur in places even far removed from what are traditionally understood as urban areas. Using urbanity, we will be more successful in assessing and visualizing the potential for structure and functioning as well as the sustainability of places such as socio-ecological urban and rural systems.

Cross-scale and cross-region analysis of global forest change from 2000 to 2012

Kurt Riitters, USDA Forest Service; James Wickham, US Environmental Protection Agency; Jennifer Costanza, North Carolina State University; Peter Vogt, European Commission Joint Research Centre*

We report a global assessment of forest interior dynamics from 2000 to 2012 that demonstrates cross-scale and cross-region analysis of remotely-sensed forest change data. Using existing maps of tree cover, disturbance, and recovery derived from Landsat data, we examined the spatial patterns of total forest gains and losses at 0.09-ha (pixel) scale to evaluate changes of relatively un-fragmented forest interior area at 1-km2 (landscape) scale. Changes in forest area underestimated forest fragmentation; a 1.71 million km2 (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. The difference in loss rates was pervasive; among 433 ecological regions in forest biomes, the median net losses of all forest area and forest interior area were 1.9% and 8.0%, respectively. 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.

Structuring and genetic diversity of Euterpe oleracea, a keystone species within gallery forests of Mearim Basin, MaranhÃ£o Amazon, Brazil.

Edyane Moraes dos SANTOS1, Milton Cezar RIBEIRO2, Larissa BARRETO1, John Wesley RIBEIRO2; Juliana Silveira dos SANTOS2, Carolina CARVALHO2 1.Universidade Federal do MaranhÃ£o; Departamento de Oceanografia e Limnologia, Mestrado de Sustentabilidade e Ecos*

This work aims to analyze the structure and genetic diversity on populations of Euterpe oleracea, known as jucara or acai, in 22 fragments of a landscape located in Amazon of MaranhÃ£o State, Brazil. The genetic analysis used microsatellite markers. Genetic analyzes were divided into study by sites, analyzed by galleries and by pairs, with galleries compared pair-to-pair. The genetic response variables included: Expected Heterozigosity (He), Allelic Diversity (A), Inbreeding Rating (Fis) and Fixation Index (Fst). Amount of suitable habitat, gallery forest patch size, matrix resistance and functional connectivity metrics were used to explain genetic variables using a AIC-based model selection approach. The results showed that there is a high rate of genetic diversity with variation in He (0.682), A (2.567), and Fis was high around 0.47 (0.479). We archived high genetic diversity for E. oleracea, however, high Fis indicates a bottleneck process ascending among the populations. Heterozigosity was best explained by matrix permeability and functional connectivity, and Fis was best explained by matrix permeability, percentage of suitable habitat and gallery forest patch size. Our results showed that jucara adapted its genetic structure and its genic pool to the fragmentation conditions. The inbreeding results also revealed that the four populations found are crossing between relatives, which can determine the fixation of alleles and genetic structure of the species.

Assessing ecosystem services from two coordinated, distributed experiments on biodiversity and productivity across 30 countries (HerbDivNet and SIGNAL).

Anke Jentsch; SIGNAL consortium; HerbDivNet consortium*

A new approach in ecology of the 21st century is coordinated distributed experiments and surveys (CDE); a network of scientists or sites applying a standardized research design to tackle questions across gradients using the power of replication distributed geographically. The number of CDE networks is rapidly increasing, especially in studying diversity - ecosystem functioning relationships. Here, I report from two CDEs: 1. SIGNAL addressing ecosystem functioning and grassland sensitivity to precipitation change and climate extremes - the first, coordinated, distributed drought experiment across a large geographical gradient. 2. HerbDivNet addressing the diversity-productivity relationship (the humbacked model) of herbaceous grasslands across productivity gradients worldwide - a coordinated, distributed survey and harvest activity. SIGNAL (Jentsch 2013): At 10 ï¬eld sites across Europe and the Middle East, the impact of a locally-scaled millennium drought on primary productivity and species diversity was simulated by exposing grassland communities to experimental manipulations of 1000 year recurrence interval. Drought sensitivity differed between mesic and semi-arid grasslands, but there was an overall linear reduction of average aboveground biomass with increasing site aridity and total drought length. Remarkably, drought sensitivity was independent of site productivity and species richness. HerbDivNet (Fraser et al. 2014): At 30 field sites in 19 countries across 6 continents, a global distributed test of the unimodal relationship between herbaceous species richness and plant biomass has been initiated. This research network is designed to test the humpbacked model and explore drivers of plant diversity.

Global analyses on flowering resources across productivity gradients and grassland community types are presented.

Seasonal modeling of turtle habitat across two landscapes using remote sensing imagery

Amy B. Mui, Department of Geography, University of Toronto, Ontario, Canada; Yuhong He, Department of Geography, University of Toronto, Ontario, Canada; Marie-Josee Fortin, Department of Ecology and Evolutionary Biology, University of Toronto, Ontario*

Habitat models describe the quality and spatial distribution of areas capable of supporting populations of wildlife species. For some species, habitat can change significantly from one season to the next, which means that single-date models may overlook important habitat used at different times of the year. This intra-annual change in habitat is especially applicable to species in temperate latitudes which undergo distinct seasonal changes, and for species limited in their ability to disperse or migrate (such as reptiles and amphibians). In this study, we used multi-temporal satellite imagery (WorldView-2 and GeoEye-1) to characterize suitable habitat over two seasons (early spring, and late summer) and two landscapes (a protected provincial park, and an agriculturally-dominated landscape) in southern Ontario. Habitat for the threatened freshwater Blanding's turtle (Emydoidea blandingii) was determined using a logistic regression model based on biophysical data obtained from field measurements at turtle presence points, and paired random locations. Chosen predictor variables such as water depth and vegetation cover were extracted from remote sensing images and mapped. Results show that turtles select habitat based upon different variables during the two seasons, likely related to temporally-varying physical and behavioral needs. Habitat availability and seasonal change also differed between landscapes, with the highly altered agricultural landscape experiencing a greater decrease in available water from spring to late summer. Future habitat work for species in temperate latitudes should consider seasonal changes in habitat use and availability to adequately protect the full range of habitat needed to support the annual needs of a species.

The VOLANTE Roadmap for future land resource management in Europe

Bas Pedroli, Alterra Wageningen UR; Marc Metzger, Edinburgh University; Marcus Lindner, European Forest Instititute; Anne Gravsholt Busck, Copenhagen University; Marta Perez Soba, Alterra Wageningen UR; Marc Gramberger, Prospex; James Paterson, Edinburgh*

This paper introduces a Roadmap, identifying robust pathways to better use of Europe's land resource. Land use is inherently complex, as the product of a large number of societal processes. The development of policy strategies for making optimal use of land resources requires cross-sector cooperation. This needs to start from a thorough knowledge of the past processes; but it also needs to focus on outcomes and the policy instruments that influence the delivery of those outcomes. The VOLANTE Roadmap gives guidelines and recommendations to policymakers to improve the science-policy interface in land use matters, enhancing a co-created sustainable land use future benefiting European citizens and respecting the interests of wider global communities. The VOLANTE Roadmap provides: o three clear representative visions about future land use in Europe o associated characteristics of food, feed and fibre production, rural development, urbanisation and tourism o a set of pathways under a suite of external scenarios, to arrive at those visions o policy measures needed to achieve these visions o trade-offs for other societal values o mapping, quantification and qualitative interpretation of impacts and effects for key interests: farm income, provision of ecosystem services, hot spots of agricultural and forest production, emission of greenhouse gasses, etc. It is concluded that current land use changes are related to the past, scenarios are needed to be prepared for the future.

Visions should then define overarching themes, differing from the current trends, since incremental policy change will not achieve the land use transitions needed for sustainable development.

Landscape structure and pest regulation

Rebecca Chaplin-Kramer, Natural Capital Project, Stanford University; Daniel Karp, The Nature Conservancy, University of California, Berkeley

Food demand will double by 2050, driven by shifts in diet and population growth. Extraordinary increases in food production have occurred before, though at great cost to biodiversity and Earth's life support systems. Conservation activities in farmland are assumed to compromise crop productivity; however, win-wins may be achieved by focusing conservation on ecosystem-service providing habitats and species. In the United States alone, predators of agricultural pests prevent up to US$4.5 billion in crop damage. Predators use natural habitat for breeding, overwintering, and food resources, and managing farmland t o enhance pest control can improve conservation and farm community wellbeing. However, beyond very coarse estimates and general understanding, we have no generalized predictive models of pest control to incorporate the value of this ecosystem service in specific decisions. Through an international collaboration effort at SESYNC, we are creating the first spatial model for pest control that is generalizable to multiple crops and diverse regions. Our synthesis will compile datasets for socially and economically important production systems and investigate the influence of land use on pest colonization and pest suppression, in order to facilitate the consideration of pest control services land use planning in agricultural landscapes.

Facilitated Discussion

Kristen Lear, University of Georgia; Jeffrey Hepinstall-Cymerman, University of Georgia*

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The landscape for coastal area: case study of considering about the management of nature conservation and recreational use, and land use model to maximize their ecosystem service in Ishikari coast of

Hajime Matsushima, Hokkaido University*

This presentation introduces the impact of off-road vehicles (ORVs) on coastal dune ecosystems, and discusses a way to conserve these natural resources along the Ishikari Coast, Japan, as a future landscape conservation model based on increasing ecosystem services to maximize coastal resilience. Coastal dunes are endangered landscapes in Japan because of landfill activities, urban development, sea wall construction for erosion control, "black pine forest" plantations as bio-shields, and intensive recreational use. Although the Ishikari Coast is adjacent to Sapporo, a metropolis of 2.2 million inhabitants, there are still wide dunes and natural forests. However, in spite of the rarity of dunes, the Ishikari Coast has not been protected and has been disturbed by ORV driving since the 1980's. A series of field surveys, using natural and social scientific approaches, were conducted along the Ishikari Coast and have identified impacts of ORV driving on dune habitats (e.g., dune vegetation and wolf spiders) and informed the development of an appropriate and responsive management strategy (e.g., zoning of protection areas and within seasons) to these threats. In addition, the management plan calls for increasing awareness to the importance of dune landscapes through developing clear interpretations and explanations to visitors. Increasing resilience of coastal areas is achieved through the proposed management plan and increasing awareness to the public at large.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Statistical dimension reduction and computation in spatial ecology

*Mevin B. Hooten *, Colorado State University*

In this era of "big data," formal statistical approaches for modeling large processes have become commonplace in the statistical literature. Statistical research in the preceding decade was replete with dimension reduction methods for fitting spatially-explicit models for processes on both discrete and continuous support. Many of these approaches revolve around ways to cast covariance structure (i.e., second-moment) as mean structure (i.e., first-moment). Such reparameterizations can lead to tremendous improvements in computational efficiency, but at the cost of approximation. Once viewed as a dirty word in statistics, the term "approximation" has become more accepted, in large part because of the otherwise intractable problems it allows us to solve. Landscape ecologists need to fit complicated models using large-scale spatial and temporal data sets. While many still rely on software such as BUGS and JAGS to fit these types of models, stochastic sampling methods such as MCMC may be prohibitively slow for large problems. This deficiency has given rise to newer computational approaches like emulation and variational Bayes as well as tools such as INLA and STAN. We discuss the advantages and disadvantages of these approaches for landscape ecologists and the trajectory of statistical dimension reduction in general.

Seascape drivers of community-wide genetic diversity across Hawaiian reefs

Kim Selkoe, NCEAS & U. Hawaii; Oscar Gaggiotti, U. St. Andrews; Rob Toonen, U. Hawaii.*

Understanding environmental, historical and ecological features maintaining genetic and species diversity across a landscape has broad relevance to population genetics, community ecology and conservation. Little information exists about gradients and drivers of genetic diversity, especially in marine systems. We present a first look at neutral genetic diversity patterns across 46 reef animal species throughout the Hawaiian archipelago using mitochondrial markers, and explore environmental and ecological correlates with community level genetic diversity estimates. In testing predictors, we asked how an approach based on selecting environmental proxies suggested by population genetic theory compares to common usage of exemplar species, species diversity, and patterns of endemism as proxies of genetic diversity. Despite the subtlety of spatial variation in mean genetic diversity, a small number of seascape and ecological factors were able to explain the majority of the variation in mean genetic diversity across the Hawaiian archipelago. Use of one or a few exemplar species to estimate genetic diversity failed to uncover any of these relationships. Our results potentially implicate both overfishing and recent thermal stress in reducing gene flow and diversity of reef populations. Apparent links between coral and CCA cover and genetic diversity and gene flow reinforce the importance of protecting the health of these foundational taxa to preserve the genetic integrity of coral reefs, and beg for better understanding of the feedbacks between community structure, genetics and demography on coral reefs.

Assessing the socio-economic value of multiple ecosystem services in the Suwannee River Basin, Florida

Pasicha Chaikaew, Soil and Water Science Department, University of Florida, Gainesville, FL, USA & Department of Environmental Science, Chulalongkorn University, Bangkok, Thailand; Sabine Grunwald, Soil and Water Science Department, University of Florida*

Humans are an integral part of the ecosystems in which they reside, contributing to its functions and structure, while at the same time imposing needs for services. In order to protect and conserve functioning ecosystems it is necessary to understand how humans perceive and value ecosystem

services. The objectives of this study were to investigate the perceptions of households in the Suwannee River Basin of Florida and assess their willingness to pay to protect these ecosystem services. A mail survey of 4000 households in north-central Florida was implemented, with valid responses received from 764 households (19% response rate). Respondent perceptions regarding ecosystem services were analysed using different attitude scales and preferences were assessed using a conjoint choice experiment. Findings from a conditional logit model indicated that respondents were most concerned about poor water quality, and nutrient control was the most preferred ecosystem service type to be managed, followed by agricultural productivity, and least concerned about climate/carbon regulation. Respondents favoured having county government as the agency to manage ecosystem resources, rather than the Suwannee River Water Management District or non-government organizations. Respondents expressed a strong preference for ecosystem protection programs to be implemented anywhere within the basin rather than closer to their homes. The willingness of residents to pay for ecosystem services was extremely low (<$2/household/year). The spectrum of diverse responses to this survey provided evidence that the perception and valuation of ecosystem services is based on the beliefs, needs, and preferences that people hold.

Surface Metrics: Scaling Relationships and Downscaling Behavior

Amy E. Frazier, Oklahoma State University*

Considerable research has examined the effects of changing spatial scale (i.e., grain size) on patch-based landscapes metrics with the ultimate goal of downscaling them to predict values at finer resolutions. Despite strong scaling relationships though, downscaling results have been inconsistent. Meanwhile, researchers are questioning whether patch-based metrics adequately represent true landscapes. Surface metrics offer an alternative for quantifying land cover patterns, but far less is known about their scaling relationships and downscaling potential. This research investigates the scaling relationships of surface metrics and determines their robustness for predicting values at finer resolutions. Various scaling functions are fit to surface metrics and the functions are downscaled to predict the metric value for a finer resolution. Relative error is assessed between the predicted and true values. Results show six surface metrics (Sa, Sq, Ssk, Sku, S10z, and Sfd) can be fit consistently well with a 3rd order polynomial, and those scaling functions are able to predict the value of a finer resolution surface to within 5% of the true value. However, goodness-of-fit (R2) is not a universal indicator of the robustness of the scaling function to downscale metrics accurately, and data loss during aggregation is a primary source of error in downscaling.

Traditional and Ecological Utilization of Tidal Flat Ecosystems in Republic of Korea

Jae-Eun KIM; Institution for Marine and Island Cultures, Mokpo National University, Republic of Korea

South Korea's west coast is known for its huge tidal flats. In total, these tidal flats cover an area of 2,393km2, which is about 2.4% of the country's total land area. Approximately 40% (1,036 km2) of the tidal flat area is part of an archipelago in the southwestern province Jeollanam-do. This archipelago is characterized by its island environments surrounded by mudflats and a diversity in tides and coastal sedimentary environments that is very high compared to other regions. Given these ecological characteristics, the local people take advantage of a variety of species that are traditionally produced in tidal flats, such as Maesaengyi (Capsosiphon fulvescens), Gamtae (Ecklonia cava) and Kim (Porphyra, laver). Historic records show that, already during the Joseon Dynasty in the 15th century, the local produce was considered to be more advanced than elsewhere. So, the coastal tidal flats were steadily utilized for the production of a variety of species based on traditional ecological knowledge. During the Japanese colonization, however, considerable parts of the area fell victim to reclamation to enable

agricultural food production and industrial development. Currently, various initiatives are being developed for the preservation of local people's life and culture basis on various species diversity in the region.

Decoding soundscapes of seabird Islands as a scalable conservation monitoring tool

Abraham Borker and Matthew McKown. University of California at Santa Cruz, CA

Healthy seabird colonies are centers of information exchange, and generate complex and dynamic soundscapes, often raucous and overwhelming. Seabirds are highly threatened, and while potent conservation actions exist, the hurdles of traditional monitoring on remote and challenging islands have hindered the evaluation of conservation actions and threats. Thus, we are developing tools and methods for measuring and quantifying seabird island soundscapes to provide managers and ecologists with reliable metrics of abundance and diversity on seabird islands. Our interest in soundscapes stems from the overwhelming complexity not embraced by species specific approaches, and as a potentially integrated metric of communities and ecosystem functioning. Our research has focused on how soundscapes can be used to assess relative abundance and the phenology of seabird colonies (two case studies, auklets and terns). We will also present on the soundscape impacts of a seabird conservation action, invasive rat removal on Hawadax Island. Soundscapes have great potential to inform adaptive management, but only if we can make biologically meaningful conclusions about the information they contain.

Closing Remarks & Discussion

Stuart H. Gage and Almo Farina, Michigan State University, East Lansing, MI USA and The University of Urbino, Urbino, Italy

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Safe-to-Fail" strategies to address uncertainty in urban planning and design

Jack Ahern University of Massachusetts Amherst*

Achieving urban sustainability and resilience in the 21st Century presents profound challenges to urban planning and design policy and practice. The leading paradigm of urban planning and design in the modern era was based on trust in the power of technology and knowledge to assure a stable future - the "fail-safe" model. In the 21st Century, the modern urban paradigm has evolved into a post-modern, stochastic and chaotic paradigm characterized by disturbance, uncertainty, and adaptability - the "safe-to-fail" model. This evolution parallels the evolution of successional theory from Clements' deterministic concept of the "climax" to Gleason's probabilistic and dynamic theory of succession. When applied to urban planning and design, the "safe-to-fail" model applies: redundancy, modularity, multifunctionality, (bio)diversity, and adaptative design as strategies to promote sustainability and resilience of urban systems. The "safe-to-fail" model will be illustrated with international contemporary examples of planning and design for urban sustainability and resilience.

Coupled socio-ecological systems: linking land-use decision making to local ecology

Nicholas W. Synes, University of Southampton; Kevin Watts, Forest Research, UK; Stephen Palmer, Greta Bocedi -University of Aberdeen; Calum Brown, University of Edinburgh; Patrick Osborne, University of Southampton; Justin Travis, Institute of Biological*

Individual-based models are now commonly used to study ecological or land-use systems, but inter-dependencies between these two systems are rarely considered. Ecological individual-based models generally model the environment (or landscape) as a predetermined factor upon which the study organisms have no influence. Individual-based models of land-use generally model the landscape by incorporating social, economic and climatic factors, but ignore the influence of ecological factors. For this study, a two-way interaction was defined between two recently developed models: RangeShifter, a spatially explicit individual-based model of population dynamics and dispersal, and CRAFTY, an agent-based model of land-use dynamics. Land-use in CRAFTY is determined by an economy, based on a user-defined set of capitals which represent the land's potential for different ecosystem services. A "natural capital" was defined within CRAFTY which determines the ecological potential of the landscape. Within RangeShifter, this "natural capital" determines the suitability of each cell in the landscape for the study species. The RangeShifter populations feed back upon the "natural capital" in each cell, increasing or decreasing its value according to the desirability of the species within the economy (e.g. pollinators, protected species - desirable; invasives, pests - undesirable), and influencing the decisions of land-use agents in CRAFTY. This coupled system demonstrates the importance of considering two-way interactions when studying socio-ecological systems. If feedbacks are not considered in socio-ecological systems, substantially different model outcomes can ensue.

Nestedness and turnover in the genetic diversity of marine species across the Indo-Pacific Ocean

Libby Liggins, Massey University; Eric D. Crandall, University of Hawaii; J. David Aguirre, Massey University; Michelle R. Gaither, Durham University; Chris E. Bird, Texas A&M University - Corpus Christi; Rob J. Toonen, University of Hawaii; Diversity of*

The Indian and Pacific Oceans contain much of the world's marine biodiversity, but species and genetic lineages are not evenly distributed throughout this region. Understanding the generality of genetic breaks and genetic diversity gradients is important for describing the evolution of biodiversity and assembly of marine communities in this region; however the large population sizes and high dispersal of many marine species result in consistently high genetic diversity across species ranges (based on haplotype/nucleotide diversity) and obscure genetic breaks (based on distance measures and fixation indices). Here we complement traditional population genetic measures with measures originally conceived for comparing species compositions among communities. We applied nestedness and partitioned beta-diversity measures to mitochondrial genetic datasets for >100 marine species contributed by DIPnet (formed by the National Evolutionary Synthesis Center working group 'Advancing genetic diversity research in the Indian and Pacific Oceans'). We describe genetic diversity gradients considering nestedness and turnover to identify evolutionary 'sinks' (where immigration predominates) and 'sources' (where mutagenesis is evident), and reveal the significance of nestedness and turnover in forming genetic breaks. These measures, commonly used in community ecology, provide a nuanced understanding of genetic patterns in the Indo-Pacific that cannot be detected using traditional population genetic measures.

Edge Effects on Above-Ground Biomass of Tropical Forests: Is There a Biomass Collapse?

Melina Oliveira Melito, Universidade de SÃ£o Paulo; Alexandre Adalardo de Oliveira, Universidade de SÃ£o Paulo; Jean Paul Metzger, Universidade de SÃ£o Paulo*

Deforestation is the main factor leading to biomass loss in tropical regions, but the effects of forest fragmentation are poorly understood. Fragmentation may act on biomass through the floristic and functional simplification of plant community on edge-affected areas. Conducting a systematic review we observed few studies (N=9) that explicitly evaluated edge effects on biomass of tropical forests, and was

not clear the role of edges in modulating biomass loss. Fragment size influenced the homogeneity of biomass along the patch (p=0.023). Low contrasting matrix, Eucalyptus plantation, seems to decrease the difference of biomass among interior and edge. Our review highlights the insufficient empirical evidences to support biomass collapse by edge effects. This implies that estimates of carbon emissions due to forest degradation can be misleading and the potential of tropical anthropogenic landscapes to provide carbon services is unascertained. Therefore, we propose a conceptual model linking landscape characteristics with biomass. We hypothesize that biological flow among patches is drastically affected below a threshold of habitat availability, and populations's maintenance are at risk. The reduction of habitat availability below this threshold decrease the number and size of patches, and edge effects reaches patch's central area, leading to a biomass decline. Matrix type also influences biological flow among patches as well as the magnitude and extent of edge effects. Those matrix influenced processes can mediate biomass amount along the fragment. Thus, considering biomass responses to landscape characteristics we would be able to determine the most friendly landscape for biomass stock conservation in tropical forests.

Rapid and Heterogeneous Vegetation Recovery Following the 2011 Earthquake/Tsunami: New Findings Supporting Integrated Coastal-Ecotone Management

Yoshihiko Hirabuki, Tohoku Gakuin University; Mizuki Tomita, Tokyo University of Information Sciences; Hiroshi Kanno, Tohoku Afforestation and Environmental Protection Co., Ltd.; Jun Nishihiro, Toho University; Kohei Oka, Hiroshima Institute of Technolog*

The Pacific side of northeastern Japan suffered severe damage from the 2011 Great East Japan Earthquake/Tsunami. The present landscape ecological study focused on the sand-dune coastal ecotone along southern Sendai Bay, and followed the autonomous recovery of vegetation in a space-time continuum. The research employed remote sensing analyses and on-site investigations in the Minami-Gamou monitoring site (38Â°14.1'N, 140Â°59.5'E; 550m by 700m strip; https://sites.google.com/site/ecotonesendai/). Results showed that major land-cover types, such as coastal forest and sand-dune herbaceous plant community, were destroyed by the tsunami; but varying responses to the natural disturbance (e.g., subsidence, landform change and collapsed-patterns of trees) were detected within the catenate-landscape. Precise surveys in the Minami-Gamou site showed that some unique plant communities in specific habitats narrowly survived as small patches. A number of plants were also observed to be recovering from buried/drifted seeds and/or subterranean organs in 2011; and most of these flourished and bore seeds in the following years. The research proposes an integrated landscape design that harmonized reconstruction with conservation of the fragile coastal ecotones. This study was partly supported by the Environment Research and Technology Development Fund (1-1405) of the Ministry of the Environment, Japan.

A Study of GIS Based Landscape Visual Absorption Capability - A Case of Jiuzhaigou Nature Reserve in China

Yishu Qiu, Shanghai Business School; Jun Gao, Shanghai Normal University

The evaluation of landscape Visual Absorption Capability (VAC) has vital significance for environmental management and value judgments. We used Jiuzhaigou Nature Reserve as a case to evaluate landscape VAC. We selected six evaluation factors (slope, aspect, topographic relief amplitude, vegetation richness, vegetation pattern, soil stability) and combined using GIS to evaluate the multiple dimensions of Regions-Road Segments-Samples. The study found that the Regions of Nakhi Village and Shuzheng Village have the highest landscape VAC. Seen from the middle range along a road, the change of VAC of different road segments were relatively stable and the numerical value of VAC was higher than that of

close-range. This was related to the dense distribution of plants and farther distance away from the road. Further studies showed that plants are the most direct factor that affects VAC. VAC was higher when there was a plant community composition and more complex structures of plant. Meanwhile, any slight human activity would bring intense visual impacts. VAC provides a reference to landscape protection and landscape management of other scenic spots.

Micro to megalandscapes: scaling arboreal lichen pattern and processes in the boreal rainforest

Yolanda F. Wiersma and Andrew Roberts, Department of Biology, Memorial University, Canada*

A challenge in species distribution modelling at landscape scales is the lack of ability to replicate, and hence to experiment. Manipulative experiments to test landscape-ecology concepts and the links between environment and patterns of species distribution are hard to carry out at landscape scales. Those manipulative experiments of landscape ecology principles are often done in microcosms or other lab environments and not in natural settings. Here, we will describe our novel system of "micro-landscapes" which have used to carry out replicate analyses of landscapes in natural settings. We use arboreal (tree-dwelling) lichens on the island of Newfoundland, Canada, as a model system to better understand what drives spatial patterns of biodiversity across scales. Newfoundland is known as the "boreal rainforest" because of its high lichen diversity. We overcome the challenge of lack of replication using stands and trees as "landscapes" at multiple spatial scales. This allows for validation and improvement of statistical models. Further, we have adapted remote sensing techniques and technologies to quantify the spatial patterns of micro-landscapes at very small spatial extents. Our analysis shows that lichen diversity varies at both within-tree (scale of cm) and between-tree (scale of m) extents and is related to microclimate varioation. The work breaks new ground in our understanding of arboreal lichen diversity patterns in the boreal region and help provide information that can be used in forest management to ensure forest ecology is not negatively affected by human activities.

Deforestation leakage in the South American Gran Chaco: an empirical study of company choices.

Yann le Polain de Waroux, and Eric F. Lambin, Stanford University*

The Gran Chaco, a dry woodland biome spanning parts of Argentina, Bolivia and Paraguay, is now one of the most active deforestation frontiers on the South American continent, due to cattle ranching and soybean cultivation expansion. Many of the companies responsible for this deforestation are not local, but rather have moved from other production areas, such as the core soybean production zones of Brazil and Argentina. Given important differences in deforestation regulations across the region and their relative weakness in parts of the Chaco, we ask the question whether these production companies seek out less-regulated places when making expansion or relocation decisions. A positive answer would suggest the existence of deforestation leakage in the Gran Chaco, with important implications for the design of conservation policies. In order to answer this question, we used a Mixed Conditional Logit model to single out the effect of deforestation regulations on producers' expansion and relocation decisions in the region. We ran the model on an empirical sample of 74 cattle and soybean companies that moved or expanded production at least once between 1990 and 2013, with a total of 126 movements. Our results suggest that the effect of differences in environmental regulations on production location choices is minor to insignificant compared to that of variables such as land availability, prices and proximity, and thus do not support the hypothesis of a significant deforestation leakage in the Gran Chaco.

The day after mountain forest degradation: history, consequences and restoration possibilities in the Karakorum Mountain landscape of Pakistan.

*Efrem Ferrari *, Ev-K2 CNR; Tommaso Anfodillo, University of Padova; Maria Teresa Melis, University of Cagliari*

Separating South and Central Asia, the Karakorum Mountains are among the most remote and tall on Earth, including 4 of the world's 14 peaks above world's 8000 meters peaks. These mountains, an exceptional geographical barrier, are home to communities of animals and plants from the Indomalayan and Palearctic regions which find their range limits within the Karakorum find their range limits. Among the Karakorum sky island habitats, forests are naturally fragmented due to strong climatic and topographical constraints. In addition, thousands of years of human presence haves further degraded and shrunk forest distribution, reduced its forest resilience and jeopardized life of for numerous red-list species. Mountain forests continue to face enormous anthropogenic pressures, further exacerbated by climate change. Hence, specific policies aimed at haltering the degradation drivers while supporting restoration initiatives are strongly required. Within the 10,000 km2 Central Karakorum National Park, a recently established protected area, a pilot project was initiated by EVK2-CNR to develop the first Park management plan. Following an innovative approach in which scientific research meets sustainable development, the Park has become a living laboratory where sustainable and participatory practices have been successfully implemented. This presentation focuses on the methodologies adopted and results achieved in the development of the Park Forest management plan, providing insights on this little-studied area and further mainstreaming possibilities in surrounding highlands.

A Practical Tool to Support Ecosystem Services Assessment and Management Decisions in Urban Forest Area

Vincenzo Giannico; Mario Elia; Giovanni Sanesi; Raffaele Lafortezza, Department of Agriculture and Environmental Sciences, University of Bari "A. Moro", Italy*

Assessing forest stand conditions in highly dense urban and peri-urban areas is essential to support ecosystem services planning and management as most of the ecosystem services provided are the consequence of forest stand characteristics. However, collecting data for assessing forest stand conditions requires much effort in terms of time, labor and cost. A plausible approach for addressing this issue is to establish a relationship between forest stand-level characteristics and landscape-level data derived from airborne laser scanning (LiDAR). In this study we used an area-based approach to investigate ecosystem services in urban forest areas by analyzing the relationship between carbon storage in biomass and the amount and patterns of biodiversity at different spatial and temporal scales. A model was developed using field data and the point cloud density derived from LiDAR; the coefficient of determination was 0.87. The model was validated using the Leave-One-Out Cross-Validation (LOOCV) procedure. A spatial map of the stem volume was generated from the model across the extent of the entire LiDAR data coverage. The results indicate that the model has robust predictive power and ability to accurately assess stem volume in an urban forest plantation characterized by high-density canopies (broad-leaved dominated). Consequently, the method employed in this study represents a practical tool to incorporate ecosystem services into urban areas, thus supporting land-use and management decisions.

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Symposium & Presenter Introductions

Sadahisa Kato, Ibaraki University

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Investigating climate analogues is useful for studying climate change impacts on biotope types at landscape level

Christina Weiss, Leibniz University Hannover, Institute of Environmental Planning; Michael Reich, Leibniz University Hannover, Institute of Environmental Planning*

Climate change is recognized as a future driver of biotope shifts and changes. However, for most of the European biotope types spatio-temporal changes remain unexplored. Our objective was to assess climate change impacts on complete sets of biotope types in different landscapes at the regional scale. We chose natural regions of Germany's lowlands and found analogue climates in Europe, which currently experience the climate conditions expected for our study areas in future. Biotope data of analogues was then compared with study areas. We examined scenarios A1b and A2a at four time windows from present to end of 21st century. Biotope data was derived from EUNIS database containing n=221 biotope types of EU's Habitat Directive. Reliability of the approach and biotope changes were assessed using PCAs on climate conditions, biotope types composition and an evaluation of soil properties.
Climate analogues were found southwest of study areas, mainly in France. Later climate scenarios shifted their analogues further southwest and from highlands to lowlands. The PCAs of climate and of biotope data showed the same patterns: data points of analogues cluster in clouds following each other in order of severity of climate change. Biotope types preferring warm/ dry sites increased with increasing climate change, whereas biotope types preferring medium/ cold temperatures and mesophile/ wet soils decreased.
We conclude that climate analogues are an efficient landscape-based approach for forecasting biotope type changes. Analogues can be used for further field studies at the local scale, e.g. to investigate change of community structure and biotic interactions.

The Ecology of Coho Salmon in Ground and Surface Water Strea

Gordon H. Reeves, PNW Research Station, Corvallis, OR

Coho salmon on the Copper River Delta appear to be uniquely adapted to physical characteristics of groundwater streams. Water temperatures are relatively cool and uniform throughout the year, reflecting mean annual air temperature. Spawning is 4-8 weeks later in these streams than in surface or glacial water. However, emergence in the different streams occurs about the same time. This is because groundwater streams are actually warmer during incubation and accumulate degree days more quickly than other stream types. Upon emergence, fry move to off-channel habitats, which tend to be warmer than the main channel. They exploit abundant Chironomids populations. They also exhibit diel movements with fish moving into the mainstem at dark to feed on a different assemblage of aquatic invertebrates and returning to off-channel areas presumably because warmer water provides for greater metabolic efficiency. 1+ fish are scarce in groundwater streams because of the lack of available off-channel habitat and cooler temperatures, which limits metabolic efficiency and growth, in the mainstem. As a result, the adult population is dominated individuals that spend a single year in freshwater before smolting. This contrasts with surface water streams where 1+ fish are abundant in the main channel and the majority of returning adults spent 2+ years in freshwater before smolting. The signal of climate change in groundwater streams will be more gradual and subtle than in surface water

streams. However, coho salmon populations may be strongly challenged by even small changes in temperatures, and flows, if they are constrained by their current ecological capacity.

Usage patterns of provisioning and cultural ecosystem services

Andrzej Affek, Institute of Geography and Spatial Organization PAS; Anna Kowalska, Institute of Geography and Spatial Organization PAS*

The aim of the study was to find out usage patterns of provisioning and cultural services derived from local ecosystems. The paper presents the results of a questionnaire carried out in June 2014 among inhabitants and tourists staying in the selected localities of Northeast Poland (area of high conservation value: forests cover 63%, lakes - 10%) (53Â°56â€²N, 22Â°58â€²E). The method door-to-door was applied, 117 questionnaires were collected back. The survey was anonymous. The questionnaire comprised a list of 45 provisioning and cultural ecosystem services divided into 6 groups (e.g. food, recreation). Respondents had to indicate the frequency of use within the last 3 years and fill in basic demographic form regarding age, sex, education, source of income, place of residence etc. We investigated, what are the factors that differentiate respondents in relation to their actual use in the study area. Statistical and psychometric analysis revealed that the list of the proposed 45 services (benefits of nature) may serve as a consistent scale of usage intensity of (provisioning and cultural) ecosystem services (Cronbach's Î±=0.97). To our surprise, factor analysis did not show any clear subscales. Moreover, between-group comparisons showed no significant differences, which may mean that the usage intensity of ecosystem services is a kind of independent feature of personality.

Case study on Evaluation of soil pollution situation in urban industrial wasteland

Ping SHI,Yanhua FU, Ende WANG,Northeastern University, Shenyang , China; Shuang GUO, Texas A&M University, Texas ,USA*

Urban industrial wasteland might have been affected by toxic and hazardous substances emitted by the original production activities. Consequently, pollution survey analysis and environmental risk assessment should have been conducted before redevelopment. In the paper, by surveying soil sample from waste dump, tailing pond and surrounding area in Lead-Zinc Mine, fuzzy mathematics method was adopted to establish Fuzzy Comprehensive Evaluation model as to analyze conditions of soil pollution by heavy metal and soil nutrient. It would provide important scientific basis for pollution control and ecological restoration in the mining area and thus carry out comprehensive ecological restoration in Lead-Zinc Mine. Fuzzy Comprehensive Evaluation results indicated that soil pollution by heavy metal were severe, in which could be given priority to develop forestry. Most deficient soil nutrient elements were available P and N. Due to the lack of nitrogen and phosphorus, it was necessary to improve the soil before phytoremediation.

Historical Dynamics of a Patagonian Landscape: Patterns and processes in forest cover and use since late 19th century in southern Chilean Patagonia.

Gabriel Zegers; Eduardo Arellano; Lars Ã–stlund*

At present, Landscapes in Southern Patagonian are the result of socioeconomic and ecological changes that have intensified in the last 150 years. Ecotonal zones between eastern semi-arid steppes and western Nothofagus spp. forests towards the Pacific Ocean are clear examples of these changes, where biological evidence of a pre-European landscape are still visible. This zone concentrates the most productive pastures, forests and mining resources in the region. Our objectives are to determine and quantify the historical changes in land cover and land use since late 19th century European settlement

in Patagonia; discuss the driving forces of land use and its changing effects over forest ecosystems; and evaluate the potential for natural regeneration of the forest reference cover, according to recent trends in afforestation/deforestation dynamics. A 3000Km2 area was chosen in the Rio Verde rural district (52ÂºS - 71ÂºW), where historical records from the 19th century included scientific and military expeditions, regional archives and bibliography, and oral tradition; all of which were integrated with photo interpretation of burned forest. Trends in forest cover were observed with spatiotemporal analysis of classified Landsat imagery and field sampling, integrated in a Geographic Information System. Results show the process of forest cover change over 140 years, from costal border cover and indigenous use, to its present limits in mid-altitude mountainous zones, with an average 30% loss. Natural regeneration proved a positive trend in the forest patch-grazing pasture border zones, irregularly conditioned by changes in land use pressure, a determinant factor in Nothofagus regeneration dynamics.

The Forgotten Temperate and Boreal Rainforests of the World: Going, Going, Gone?

Dominick A. DellaSala, Geos Institute

Temperate rainforests occur in just ten regions of the world that collectively make up ~ 2.5% of the world's forests. Disjunctly distributed in mid and high latitudes, they are characterized by cool to warm maritime climates, wet summers, and mild winters. All of them are rich in arboreal lichens; many have exceptionally long-lived trees (~ 3,600 years); some (Pacific Coast of North America, Chile and Argentina, Tasmania) are among the most carbon dense ecosystems in the world; they vary in species richness from low (western Europe) to moderate (Pacific Coast of North America) to high (Japan, Chile and Argentina, South Africa, Western Eurasian Caucasus); some have ancient Tertiary (Russian Far East and Inland Southern Siberia) and Gondwana (Chile, South Africa, Australasia) affinities and many harbor unique species (Japan, Chile and Argentina, South Africa, Australasia). Only six areas are relatively intact (Tongass, Great Bear, Valdivia, Tasmania, Russian Far East and Inland Southern Siberia), all are threatened by logging and climate change, protection levels (14%) are far too low to sustain critical ecosystem services and biodiversity in a time of unprecedented land-use and climate change, and some (Coast redwood, western Europe) are critically endangered and may flip to different ecosystem states with climate change. I present lessons from around the world on threats to these remarkable rainforests with climate change projections for Pacific Coastal rainforests of North America, the largest spatial extent of these rainforests in the world.

Sociocultural regime shifts in the ecology of anthropogenic landscapes

Erle C. Ellis, Geography & Environmental Systems, University of Maryland, Baltimore County

Human societies have transformed the ecology of landscapes across the Earth for millennia. As a result, it is no longer possible to understand, predict, or successfully manage ecological pattern, process or change without understanding the long-term societal dynamics that reshape the ecology of landscapes. Here, a general causal theory is presented to explain anthropogenic ecological changes driven by societal dynamics across human generational time. Building on existing theories of ecosystem engineering, niche construction, inclusive inheritance, cultural evolution, ultrasociality, and social change, this theory of anthropogenic ecological change holds that sociocultural evolution of subsistence regimes based on ecosystem engineering, social specialization and non-kin exchange, or "sociocultural niche construction", is the main cause of both the long-term upscaling of human societies and their unprecedented transformation of the biosphere. Regime shifts in human sociocultural niche construction can explain, where classic ecological theory cannot, the sustained transformative effects of human societies on biogeography, ecological succession, ecosystem processes, and the ecological

patterns and processes of landscapes, biomes and the biosphere. Sociocultural niche construction theory aligns with and integrates existing theoretical frameworks in ecology including social-ecological systems, social metabolism, countryside biogeography, novel ecosystems and anthromes. In the Anthropocene, human sociocultural processes must become as central to ecological theory and practice as biological and geophysical processes are now. Strategies for achieving this goal and for advancing ecological science and conservation in an increasingly anthropogenic biosphere are presented.

Eco-evolutionary impacts of poaching among forest and elephant subspecies in Africa

Samuel K Wasser, Department of Biology, University of Washington

Poaching has reduced African elephant populations from 1.3 million individuals in 1979 to < 450,000 by 2013; over 50,000 elephants were killed in 2103 alone. Among the two subspecies, forest elephants have been more heavily impacted than savanna elephants, with almost 90% killed in the last 50 years. Genetic, demographic and ecological repercussions from this loss could be considerable. Here, we discuss one such example: eco-evolutionary dynamics and possible implications of hybridization between forest and savanna elephants. Hybridization between these two subspecies is historically rare, with only 3 genetically-confirmed hybrids reported to date. However, we recently discovered a major hybridization zone along the northern portion of the Albertine Rift, an area of exceedingly high endemism in Africa spanning the southern half of the DRC-Uganda border; 38 out of 102 samples from that area were unique hybrids. Genetic analyses revealed that the majority of these were second generation or older, with mothers and fathers from both subspecies. Several lines of evidence suggest that this hybridization resulted from forest elephants fleeing the asymmetrically high poaching on the DRC side, despite strong habitat affinities that evolved during the subspecies' 3 million years of geographic separation. This raises several important questions: What will be the impact if hybridization scrambles the habitat affinities and diet preferences among these elephants? How will this impact species that co-evolved with only one of the two elephant subspecies, as well as human-elephant conflict? Will concurrent habitat loss slow backcrossing, delaying the re-purification of these sub-specific genotypes?

Tribute to Professor Oliver Rackham and Debate on Biocultural Landscapes

Gloria Pungetti, CCLP, University of Cambridge, UK

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Modeling the impact of hydrological alterations: Shifts in Eurasian spoonbill habitat in Poyang Lake, China

Benjamin Sullender, University of Wisconsin-Madison; Janet Silbernagel, University of Wisconsin-Madison; Jeb Barzen, International Crane Foundation*

Poyang Lake, the largest freshwater lake in China, provides critical wintering refuge for over 300 species of migratory waterbirds. Suitable habitat for these birds, including an available and abundant food supply, is largely driven by a seasonal flood-pulse system fed by the Yangtze River. In an effort to protect traditional livelihoods such as agriculture and fishing, people have manipulated local hydrology to a great extent. Currently, little is known about the ecological impact of these alterations, and understanding this relationship has become more urgent in the face of regional changes including a proposed Yangtze-Poyang outlet dam that would disrupt the flood-pulse dynamics. To quantify the role of hydrology in driving habitat suitability, I used a hybrid approach integrating behavioral observations with long-term monitoring data in Poyang Lake National Nature Reserve. I selected the Eurasian

spoonbill (Platalea leucorodia) as an indicator for co-occurring waterbirds of concern such as the endangered Oriental stork (Ciconia boyciana). Within wetland ecosystems, spoonbills have been widely used as umbrella species to assess hydrological changes. In winter 2014-2015, I conducted a series of focal and scan samples to determine flock-wide activity budget and identify characteristics of preferred habitat. These field observations indicate that water level is the primary driver of habitat suitability due to its role in both spoonbill behavior and foraging success rates. I used these findings to inform a spatially explicit logistic regression model of spoonbill habitat based on survey data from 2000-2015. After determining the baseline relationship, I adjusted input parameters based on scenarios representing potential hydrological changes. These simulations suggest that lower winter water levels would displace, reduce, or entirely eliminate available habitat. Although altering hydrology may benefit human livelihoods, changes exceeding the narrow envelope of suitable water depths for foraging could have dramatic impacts on waterbird populations.

Tracking Public Health in Landscapes: GIS of Rattus norvegicus Landscape Genetics in Salvador, Brasil

Burak, M. K., Richardson, J. L., Costa, F., Childs, J. E., Ko, A. I., and Caccone, A.
International Association of Landscape Ecology World Congress, Portland, OR.

Humans have been migrating to urban areas in large numbers for the past half-century. More than half the world's population now lives in cities, and this trend is projected to continue well into the future. Increased urbanization has important consequences for the landscape around urban core habitats, a pattern even more dramatic in developing countries. Salvador, Brasil is a city that has experienced a 280% increase in its population since 1970. The city now consists of three million residents, with the added population concentrated in rapidly expanding slum settlements (favelas) characterized by refuse piles, open sewage, and overgrown vegetation. Such environments promote rodent infestations, principally of the Norway rat (Rattus norvegicus) - a reservoir host for the zoonotic pathogen that causes leptospirosis. Seasonal leptospirosis outbreaks occur in favelas during the wet season. Costly public health campaigns have been proposed to eradicate this rat vector, and managers have requested information on their movement patterns and landscape corridors in order to target these eradication efforts. We estimated the amount of gene flow occurring within and across seven favela communities in Salvador for 780 Norway rats trapped over 5 years. We used genetic data to characterize the role that the landscape plays in shaping the gene flow among rat sampling locations. We also used spatial GIS analyses to quantify the relationship between the Norway rat movements and topography, trash disposal and socioeconomic measures in Salvador. Several human-associated aspects of the landscape had detectable effects on rat movement, and consequently gene flow. This information will be used directly to target future eradication strategies by public health authorities in the area.

Multiscale analysis of landscape heterogeneity as a support tool for ecosystem services planning

Emilio R. Diaz-Varela, University of Santiago de Compostela; Jose V. Roces Diaz, University of Oviedo; Pedro Alvarez-Alvarez, University of Oviedo.*

One of the essential aspects to be addressed in the integration of Ecosystem Services (ES) in landscape and land use planning procedures is the adequate match between the spatial levels of ES supply and the scales of planning. To do so, an important first step is to take into consideration the spatial complexity of the ecosystems and how such complexity is organized at the landscape level. The analysis of landscape heterogeneity is a useful tool for both the detection of spatial patterns, the estimation of ecosystem functioning parameters, and the delineation of landscape planning units. Nevertheless, despite important advances in the study of spatial heterogeneity and complexity in the last decades, further

research and improvement of methods are still needed. In this work, spatial heterogeneity in the landscapes is addressed using a multiscale approach using dissimilarity-based metrics. A semantic approach towards the ES supply characterization is integrated, defining a feature model for each ES. The detection of both qualitative and qualitative differences at the spatial level enhances the interpretation of heterogeneity, thus allowing for a more pragmatic use of the derived information. The results underline the importance of a multi-level consideration towards ES supply, and the risks of trade-off underestimation in cases where the planning scale is not correctly addressed.

Lessons from Historical Salt Marsh Landscapes

Emily W. B. (Russell) Southgate, Hood College

Nineteenth century coastal landscapes, especially salt marshes, often served dual functions by providing ecosystem services even after being "reclaimed" as farmland. Two such mixed salt marsh landscapes in northern New Jersey provide examples of the integration of cultural and physical drivers of ecosystem structure and function. The salt marsh at one site, Constable Hook, Bayonne, was diked to grow salt hay, run at least one mill and create salt ponds. Because of a difference in tidal flow, the other, in Linden was managed less intensively. In both landscapes, dryer ground was used for conventional farm crops and buildings. While both marshes have been almost entirely obliterated by 20th century construction, historical documents provide spatially and temporally explicit descriptions of these salt marsh landscapes and their uses. The examples demonstrate the loss of functioning landscapes when cultural use and physical and biological drivers become decoupled, so that the cultural use no longer treats the ecosystems as resources but rather views the land as a passive background for industrial uses. The historical reconstructions can also provide models for restoration ecologists seeking to restore multi-functional landscapes.

Landscape history matters - impressions from the hemiboreal zone

Timo Pitkanen, University of Turku; Niina Kayhko, University of Turku; Helle SkÃ¥nes, University of Stockholm*

Understanding landscape history and its previous disturbances is essential for interpreting many contemporary phenomena that otherwise appear to be coincident. This concerns all the landscape components but is especially significant for plant species' distribution as they are sessile organisms but often resistant and long-living enough to persist in gradually changing conditions. Importance of landscape history is however not always analyzed in a systematic manner, reflecting the multitude of historical effects and tediousness of extracting the relevant information in respect of the studied phenomenon. This paper summarizes experiences and impressions from a few case studies, concerning mainly species rich non-intensively managed semi-natural grasslands in South-Western Finland. It concentrates on observations of what historical phenomena have been found to be crucial for understanding present conditions, how does this information help in supporting spatial planning and how can we contribute to future research by providing good-quality information of the contemporary landscape. Presentation points out some critical issues, potential pitfalls and best practices that have been noticed on the studies, thus promoting efficient and workable strategies to successfully tackle with landscape history.

Work and recreation - why daily forest visits make sense

Kerstin Ensinger1, Matthias Wurster 2 1Black Forest National Park, Department of National Park Planning, 2 Forest Research Institute (FVA) Baden-Wurttemberg, Department of Forest and Society, Freiburg, Germany

The detrimental effect of daily strains on health and well-being has been well established. For example exposure to job stressors may directly elicit potentially harmful physiological responses as well as indirectly via unhealthy life styles. It is not just the dramatic stressful events that exact their toll, but rather the many events of daily life that elevate and sustain activities of physiological systems and cause sleep deprivation, overeating, and other health-damaging behaviors, producing the feeling of being "stressed out." Recovery, as an antagonist of stress is a process of psychophysiological unwinding after exposure to demands and stressors, plays a crucial role in protecting people against adverse effects. Our study uses a mixed methods approach including qualitative and quantitative methods. The data consist of 2 telephone surveys (respectively n=2000) and 25 qualitative interviews. Our findings suggest that persons share different notions and concepts of recreation depending on their current life situation. Particularly in the face of workload, the forest is discussed as a place you visit, because of what there is not, so as an alternative concept to a stressful life. Psychological detachment, which is inevitable for a successful recreation can be experienced in different modalities within forests. The findings exemplify that such insights can be achieved through an interdisciplinary approach and methodological triangulation.

Contribution of connectivity metrics to the assessment of biodiversity - some methodological considerations

Matthias Pietsch, Anhalt University of Applied Sciences, Germany*

Land use change and the physical and functional disconnection of ecological networks represent one of the driving forces of biodiversity loss. Beside a lot of different methodologies network analysis and graph theory provide powerful tools and methods for analyzing ecological networks. Graph-theory in combination with cost-distance modeling are tools that might be helpful to reduce negative ecological impact and find appropriate solutions in the landscape planning process. These methods can be used as evaluation tools in the planning process or to analyze and visualize different possible scenarios for the participation process or to define areas that are most important for specific measures. In the presentation the methodological background will be described and the implementation in the planning process discussed.

Environmental DNA Assessment of Vertebrate Biodiversity in a Kelp Forest Ecosystem

Jesse A. Port, Stanford University; Jimmy O'Donnell, University of Washington; Ofelia Romero-Maraccini, Stanford University; Paul R. Leary, Stanford University; Steven Y. Litvin, Stanford University; Kerry J. Nickols, Stanford University; Ryan P. Kelly,*

The ocean is a soup of its resident species' genetic material, cast off as metabolic waste, damaged tissue or sloughed cells. Sampling this environmental DNA (eDNA) is a potentially powerful means of assessing whole biological communities and offers a more efficient, less expensive and less invasive approach than conventional methods for monitoring biological diversity. To test and validate and this approach, we surveyed the vertebrate fauna present along a 2.5 km transect in Monterey Bay using both eDNA and visual observations. The transect passed through a gradation of habitats, including seagrass, kelp forest, rocky reef, sandy bottom and open water. We find broad - although not perfect - agreement between the visual and genetic surveys, with the latter offering generally higher detection rates. Spatial patterns of eDNA were consistent with known distributions for bony fishes and marine mammals. Perhaps surprisingly given the fluid nature of the marine environment, we find significant differences in eDNA that reflect the vertebrate community assemblages of different habitats separated by as little as 60-100 m. These results suggest that, even in a dynamic nearshore marine environment, eDNA generation may

substantially outpace the combined forces of degradation and advection, and that consequently eDNA from seawater samples can offer a high-spatial-resolution view of animal communities.

Characterizing Changes in Discharge and Water Temperature Through the Lens of Phenotypic Diversity

Rebecca Flitcroft, USDA Forest Service, Pacific Northwest Research Station; Ivan Arismendi, Oregon State University, Department of Fisheries and Wildlife; Sarah Lewis, Oregon State University, College of Earth, Ocean, and Atmospheric Sciences*

Adaptation to environmental conditions is a cornerstone of population-level resilience. Stream discharge and temperature have long been recognized as key environmental drivers for aquatic biota. Predictable hydrologic conditions over time allow for the development of heritable life history strategies for aquatic species. Pacific Northwest salmonids demonstrate strong adaptive capacity to use available stream habitats, and heritability in the timing of life stage events, such as spawning migration. This adaptive capacity means that Pacific salmon may be able to respond to changes in the regional hydrologic template. Further, the signal of this response may be detectable in the distribution of behaviors exhibited at a population-level. Here, we propose an empirically based framework of stream temperature and discharge that characterizes the hydrologic regime and through which we may consider life-stage behaviors of salmonids or other aquatic species. We illustrate the use of this framework using the population of Coho Salmon (Oncorhynchus kisutch) in the North Umpqua River Basin, Oregon. This population shows a distinct phenology of mid-river run timing under specific conditions of stream temperature and discharge when compared to populations of Chinook salmon (Oncorhynchus tshawytscha), or steelhead trout (Oncorhynchus mykiss). Predictions of future climate effects on aquatic species that do not consider life-stage specific behaviors in the context of the local hydrogeomorphic setting may overlook the importance of species-specific adaptive capacity. Our framework allows for behaviors to be considered within the context of the hydrologic regime, and can identify vulnerability of sections of the population or life stages based on phenology.

The need for process-based models of land use change at large scales

Calum Brown, University of Edinburgh; Sascha Holzhauer, University of Edinburgh, Jasper van Vliet, Vrije Universiteit Amsterdam; Peter Verburg, Vrije Universiteit Amsterdam; Mark Rounsevell, University of Edinburgh*

Models of land use change provide an experimental setting for studying the behaviour of the land system and its possible future development. The value of these models depends upon their ability to represent certain aspects of the modelled system, while balancing real-world relevance and counter-productive complexity. Land use models frequently strike this balance, in part, by assuming homogeneous, economically-rational behaviour on the part of land managers, allowing the use of 'top-down', pattern-based economic-based models that simulate trade of goods and services at national to global scales, and the downscaling of results to determine land use outcomes at smaller scales. Alternatively, the land system can be conceptualised and modelled as the result of the actions and interactions of individual land managers, populations, institutions and societies in extracting desired goods and services from their environment. This conceptualisation suggests a 'bottom-up', process-based modelling approach that simulates behaviour at the individual level and allows properties of the system as a whole to emerge. Here, we outline the philosophical and empirical basis for such an approach, and investigate its value in theoretical and real-world settings. We use simulations of an agent-based model of land use change to identify important behavioural effects and to assess their potential relevance to real land systems. We also present a new agent-based model of European land

use to demonstrate these effects, and the scope for including them in land use models that operate over large geographical extents.

BULC: Bayesian Updating of Land-Cover Classifications for Landscape Ecology Studies

Jeffrey A. Cardille, McGill University Julie Fortin, McGill University Jaaved Singh, McGill University

Many landscape ecologists are interested in understanding how land-cover change affects ecological processes, yet it's often difficult to begin analyses without first committing to months of diligent remote-sensing work gathering and interpreting images. Even so, a comparable set of land-cover maps is usually only the first part of a study. Without a straightforward way to update existing maps to a desired date or classification legend, we are left to use maps that are often distinctly outdated with categories that don't quite fit. Meanwhile, with the opening of the Landsat record and the launch of new satellites, a very large amount of satellite imagery is now available. To address this challenge, we developed the new BULC algorithm for the continuous updating of land-cover classifications through time. The algorithm ingests classified land-cover data of variable quality, and is designed to allow users to adjust a given classification in time to any desired date. The algorithm produces credible land-cover maps through time: here we show a successful test of BULC with Landsat 8 data in central Quebec, which witnessed a series of large forest fires in summer 2013. Fusing 10 images of widely varying quality, our algorithm mapped fire borders as they grew throughout the summer. The land-cover sequence was better than many of its component days, which were often contaminated by fire haze and clouds but nevertheless contained useable information. As landscape ecology enters a new era of data richness, the BULC algorithm may help non-experts make useful maps with a minimum of expertise and human intervention.

Combining CLUE-S and InVEST Models to Simulate and Evaluate Coastal Land Use Change -- A Case Study of Coastal Wetlands in Central Jiangsu Province,China

Caiyao Xu, School of Geographic and Oceanographic Sciences, Nanjing University, Nanjing, China; Lijie Pu*, School of Geographic and Oceanographic Sciences, Nanjing University, Nanjing, China; Jianguo Li, School of Geographic and Oceanographic Sciences,*

Land use change is one of the global environmental change research hot fields, as well as the core of landscape ecology research content. Coastal zone, which is extremely sensitive to ecological response, has a strong interaction between the continent and ocean and is becoming a hot spot of land use change research area. The reclamation of tide flat has become an important measure to solve the contradiction between population and land resource. Jiangsu's coastal wetland area with a long history of reclamation is the largest natural salt marsh wetland of eastern China. In this paper, five remote sensing images (1977, 1984, 2000, 2007 and 2014) were obtained to explore the relationship between landscape types and driving factors for the past almost 40 years in coastal wetlands and reclamation area of central Jiangsu Province through the GIS and RS technology. Auto-Logistic regression model was used to determine the final driving factors while CA-Markov model was used to calculate the future demand for land allocation. This study simulated different land use change scenarios of coastal zone in central Jiangsu Province by Dyna-CLUE. Meanwhile, it evaluated the simulation results of land use change under different scenarios with the InVEST model, then put forward some suggestions and countermeasures on the evaluation results.

Symposium Introduction

Benjamin Burkhard, Marion Kruse, Felix Muller; Kiel University*

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

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Environmental health benefits of urban forests in Hangzhou, China: Findings from three-year continuous monitoring

Jun Yang, Center for Earth System Science, Tsinghua University; Bin Ye, Research Institute of Forestry Policy and Information, Chinese Academy of Forestry*

Urban forests can improve the health of urban residents. However, there is a knowledge gap on how the health function of urban forests is generated. In this study we examined the biophysical basis for the health function of urban forests through a method combing field works and continuous monitoring. We built automatic monitoring platforms on three typical types of urban forests (suburban forest, forest park, residential green space) and one control site (central city area). Six variables including air temperatures, relative humidity, wind speeds, concentrations of carbon dioxides, concentrations of anions, and noise levels were monitored continuously at each site. We also used a biometeorology model to analyze the level of human comfort at each site. Our results revealed the dynamic changes of these variables and the level of human comfort at each sites. The effects of community structures of the urban forests on the variation of ecological health function of these forests were also discussed. Finally, we made recommendations on the best time to take activities in different types of urban forest and on the optimal arrangements of plants to achieve the maximum health benefit.

Condition of Conservation of Wetlands in Tabasco, Based on its Shape

Coral J. Pacheco-Figueroa, DACBiol-UJAT; Elias Jose Gordillo Chavez, DACBiol-UJAT; Lilia Maria Gama Campillo, DACBiol-UJAT; Juan de Dios Valdez Leal, DACBiol-UJAT; Ruth del Carmen Luna Ruiz, Eduardo Moguel Ordonez, Luis Jose Rangel Ruiz, DACBiol-UJAT;*

The extreme fragmentation and loss of natural wetlands, causing the detriment of a large number of species (Faulkner 2004). In Tabasco reduce fragmentation is relevant to the conservation of natural ecosystems. So it fragmentation of different wetland described. Were used landscape metrics at the class level, assessing its composition and configuration. The composition was calculated according to the number of fragments, average fragment size, amount of area for each type of vegetation and land use. The complexity of the landscape was measured using the shape of Patton index (1975), the degree of compaction and landscape level the degree of fragmentation. The Tabasquenos wetlands still have a wide coverage, but highly fragmented. The compaction index shows little exposure to the negative effects of the matrix, so they have a huge potential to recover. However, the degree of fragmentation of Tabasco wetlands places them vulnerable to all threats. The integrity that still preserve wetlands provides opportunities to recover. Wetlands are being undervalued as an ecosystem of great value in the state, which transforms quickly. For this reason it is necessary to take concrete measures and actions on its conversion to pasture, or areas of human settlement.

Temporal dependency of NDVI satellite imagery for predicting French breeding birds diversity

David Sheeren, Solenne Lefevre & Sebastien Bonthoux*

Remote sensing data are now commonly used in landscape ecology. It offers several ways to provide indirect surrogates of landscape heterogeneity patterns which can be related to ecological processes. Past studies have widely used NDVI imagery as proxy to explain species diversity but few of them examine the effect of its seasonality to predict bird biodiversity at broad scale. Here, we assess the effect of acquisition date of NDVI to explain bird community patterns in France. Species richness of specialists and generalists to habitat were estimated on 1091 samples from the French Breeding Bird

Survey. To accommodate for seasonal variation, MODIS 16-day composite NDVI imagery acquired in March, June, August and September 2010 were used. The 12-month time series of 16-day composite NDVI was also retained to encompass the entire growing season of the year. Landscape composition and heterogeneity were measured through NDVI data at each time period and through a non-supervised functional classification. Generalized Linear Models were fitted to explain and predict species richness of bird communities. Results show a strong influence of the acquisition period on model response (e.g. difference in DÂ² = 32% between NDVI of March and June 2010 for the species richness of forest birds) and highlight the need to take care of NDVI phenological variation when constructing bird-habitat model.

Land Use Changes and their Impact Biodiversity in High Mountain Ecosystems:

Bhagwati Joshi, Department of Geography, Government Post Graduate College Rudrapur, Uttarakhand, India

Himalaya constitutes one of global biodiversity hotspots exhibiting a range of micro-habitats with great biodiversity. During recent past, a variety of changes emerged in traditional land-use pattern in response to population growth and resultant increased demand of natural resources. This depleted forest and biodiversity and disrupted ecosystem services. Paper interprets nexus between land-use dynamics and biodiversity with case study of Kosi Catchment , Uttarakhand Himalaya. Remote sensing techniques along-with qualitative and quantitative empirical methods used for monitoring land-use dynamics, and landscape ecological analysis was carried out for assessment of biodiversity. Results indicated 4.36% forest decreased, declining dense forest-cover (15%), reducing forest-canopy (60%), increasing landscape fragmentation (21%), disrupting habitats (47%) and decreasing biodiversity richness (17%) during last 30 years. Steady erosion of biodiversity adversely affected livelihood of forest-dependent communities constituting 75% rural population. Moreover, biodiversity based ecosystem goods and services that support mountain livelihoods, habitats provisioning for biodiversity, rainwater-storage in vegetation-soil pool, hydrological-system, carbon sequestration potential and cultural values are likely to deteriorate further under rapidly changing climatic conditions. It is therefore, highly imperative to consider biodiversity conservation as one of the essential components of integrated land-use policy, so as to evolve realistic and integrated framework for biodiversity management in Himalaya.

The historical basis of fuels management in the mixed-ownership landscape of the Eastern Cascades Ecoregion, Oregon

Michelle M. Steen-Adams, University of New England; Susan Charnley, Pacific Northwest Research Station, USDA Forest Service; Mark D.O. Adams, University of New England*

Global climate change and wildland urban interface (WUI) settlement call for public land forest managers to apply a coordinated, whole landscape approach to wildland fire and fuels management. Yet the cumulative history of wildland fire policy has promoted a fragmented situation. The Forests, People, Fire (FPF) project examines human response to forest landscape condition (fire risk, forest resilience, and ecosystem services metrics) as an integrated social-ecological system. This study, which contributes a historical perspective to the FPF project, examines the cumulative influence of social factors on fuels and forest management as a social-ecological feedback. We examine the long-term influence of social factors (policy, culture, and forest product markets) on wildland fire institutions and practices, consequent forest landscape structure and change (1930s-1950s), and policy responses. Consistent with the project's whole landscape approach, we examine variation in human-landscape interactions among forest ownerships. We employ a mixed methods approach, consisting of landscape change analysis derived from historic forest surveys, oral history interviews, and document analysis, to develop a suite

of landscape change narratives. Our study demonstrates how a historical perspective can expand understanding of fire-prone landscapes: we reveal contributors to unintended consequences and illuminate underlying social drivers of forest landscape decision-making.

Development and application of a spatial IBM to forecast greater prairie-chicken population responses to land use in the Flint Hills region of Kansas

Breanna F Powers, US EPA Western Ecology Division; Dr. Nathan Schumaker, US EPA Western Ecology Division*

Greater prairie-chicken (Tympanachus cupido) populations have been on the decline for decades. Recent efforts to reverse this trend are focusing on two specific disturbance regimes, cattle grazing and field burning, both prevalent in the Flint Hill region of Kansas -- an area of critical prairie-chicken habitat. Field burning and grazing is necessary for arresting the transition of prairies into woodlands, but fire application (frequency and timing) is managed to optimize livestock production, and thus may not be ideal for prairie-chicken preservation. Not surprisingly, it is completely infeasible to perform real-world tests that might quantify the relationship between fire management and prairie-chicken population trends at large spatial scales. We addressed this constraint by developing a spatial IBM (individual-based model) capable of forecasting prairie-chicken population trends and their responses to multiple interacting disturbance regimes. Here, we report on our initial results from this work, in which we have examined how sensitive prairie chicken population trends are to changes in landscape structure.

Farmland abandonment and intensification in Europe since 1990

Tobias Kuemmerle, Geography Department, Humboldt-University Berlin, Germany and Integrative Research Institute on Transformations in Human-Environment Systems, Humboldt-University Berlin, Germany; Stephan Estel, Matthias Baumann, Christian Levers - Geogra

Human-dominated landscapes across the global are undergoing a twofold process of cropland intensification and abandonment. Both trends threaten traditional landscapes and their farmland biodiversity, yet data on these land-use trends is scarce, particularly across larger geographic extents. Our goal here was to use satellite data and agricultural statistics to map cropland intensification and abandonment in Europe since 1990. We carried out three analyses. First, we used MODIS NDVI images from 2001-2012 to map permanently unused farmland, as well as recent cropland abandonment and recultivation. Second, we generated Landsat image composites for +/- 1990, 2000, and 2010 to identify the timing of abandonment. Third, we use downscaled agricultural statistics related to inputs (e.g. fertilizer use) and outputs (e.g., yields) to map management intensity changes. Collectively, our analyses highlight that cropland abandonment and intensification occur spatially highly clustered. In Europe's West, abandonment occurred mainly in mountain regions (e.g. Pyrenees, Alps), whereas many cropland areas in Central European experienced intensification (e.g. Germany, Northern France, the Netherlands). In Europe's East, the breakdown of socialism resulted in a pulse of farmland abandonment, yet recultivation of unused farmland became an important land-use trend after 2006 (e.g., in Poland and the Baltics). Similarly, agricultural intensity dropped after 1989, but increased after 2000. Most areas in Europe were dominated by either intensification or abandonment, suggesting an increasing polarization of land use patterns. This, and the clear East-West separation we found, emphasizes the need for more context-specific, regionalized land-use policies to manage Europe's cultural landscapes and to preserve their heritage.

Effects of tidal creeks on land use/cover and ecosystem service value change in a reclaimed eastern coastal region of China

Meng Zhang, School of Geographic and Oceanographic Sciences, Nanjing University; Lijie Pu, School of Geographic and Oceanographic Sciences, Nanjing University & Key Laboratory of the Coastal Zone Exploitation and Protection, Ministry of Land and Resource*

China possesses a vast supply of tidal flat resources, and reclamation-converting the flats to drier, more stable lands by draining and filling-has frequently been applied as a means of developing these regions. Micro-relieves (e.g. tidal creeks) which provide important ecosystem services shape tidal flat landscapes' patterns prior to reclamation and affect land-use change after reclamation. The high-saline nature of the soils means that converted flats cannot easily be converted to agriculture and are left as barren land. However, with the appropriate management, these areas could be colonized by salt-tolerant plants and become habitat for local animals. The key is to understand how landscapes and ecosystem services change at reclamation zones over relatively long time horizons. We selected coastal regions of Dongtai, Jiangsu, China as our research sites. These areas have a long history of reclamation (over 1000 years) and have many tidal creeks. We investigated changes of land use/cover and ecosystem services between 1984 and 2014 and determined that there is a high probability that tidal creek regions will be used as aquiculture pools or left unused. Overall, however, agriculture is the main land-use type that results after remediation. Land use/cover changed intensively at the beginning of reclamation for 30 years and then slowed and stabilized. Ecosystem services dropped significantly at first and then often increased smoothly after the first 10 years. These results indicate micro-relief factors should be taken into consideration in land-use planning and that further study of the ecological consequences of newly reclaimed land is warranted.

Carbon legacies of land use: development, impact and future consequences

Nynke Schulp, Peter Verburg; VU University Amsterdam

Among the controlling factors for carbon stocks and carbon sequestration rates in the soil, land use is the most variable. While soil properties are stable and hydrology and climate change gradually, land use can change overnight through e.g. deforestation or sealing. It is known that after a land use change, changes in soil organic carbon (SOC) stocks respond with a time lag. Although the input quality and quantity and conditions for decomposition change immediately, it takes a while before a new balance between input and output is reached, let alone a new equilibrium SOC stock. It has consequently been demonstrated that the spatial variation of SOC stocks is rather a carbon copy of the past land use trajectory than of the current land use pattern. There is an ongoing interest in maps of the SOC stock, projections of possible future changes, and insight in the impact of land use management on these changes. While the time lag effects are known, quantification of these effects and insights in the impacts of time lags on modelling future carbon stock changes is missing. In this presentation, the development of carbon variability over long-term land use trajectories will be explored. Recent progress on quantifying land use history at different scales will be presented, together with simulated and measured impact on carbon stocks in soil and vegetation. With the help of carbon stock models, the importance of accounting for past changes in projecting future changes will be demonstrated.

Demographic analysis of Agave angustifolia (Agavaceae) with an emphasis on ecological restoration

Luis Antonio Arias-Medellin & National Autonomous University of Mexico; Consuelo Bonfil & National Autonomous University of Mexico; Teresa Valverde & National Autonomous University of Mexico

We studied the demography of Agave angustifolia on a preserved tropical dry forest (Xochicalco), and on a pastureland area that has been used for cattle grazing (Tembembe) to test whether this agave could thrive on deteriorated habitats left after cattle ranching. Seed germination and seedling survival

experiments were carried in the field. We used Lefkovitch matrices, elasticity analysis and Life Table Response Experiments (LTRE) to model and compare the demography of both populations. Numerical simulations were performed to project the effect of the harvest of inflorescences and seedling introduction. Seedling survival and seed germination were highest in Tembembe. The population growth rate (Î») was higher in Tembembe (Î»T =1.268, C.I.95%: 0.952-1.452) than in Xochicalco (Î»X =1.208, C.I.95%: 1.061-1.340). Elasticity matrices showed that stasis and growth were the demographic processes that contributed most to Î». LTRE showed that differences between the two sites were due to a lower fecundity and stasis in Xochicalco. The numerical simulations of inflorescence harvest showed that Î» did not drop below unity even when all inflorescences were eliminated. Simulated introduction of seedlings rised Î». These results suggest that this species could be successfully used in ecological restoration programs.

Finding Plants Adapted to Multiple Climate Extremes: Using Genecology and Ecophysiology to Identify Drought Resistant and Cold Hardy Populations of Douglas-fir

Sheel Bansal, USDA Forest Service Pacific Northwest Research Station; J. Bradley St. Clair, USDA Forest Service Pacific Northwest Research Station; Constance A. Harrington, USDA Forest Service Pacific Northwest Research Station*

Drought and freeze events are two of the most common forms of climate extremes that result in tree damage or death, and the frequency and intensity of both stressors may be altered with climate change. Consequently, identifying populations of species that are (and are not) genetically well adapted to both desiccation and cold stress (i.e., stress hardiness) is critical for successful regeneration of ecologically and economically important species such as coast Douglas-fir (Pseudotsuga menziesii var. menziesii) in the northwestern US. We measured ecophysiological traits associated with drought resistance and cold hardiness on 35 populations of Douglas-fir growing in three common gardens. We then used principal components analysis to merge drought resistance and cold hardiness trait data into master 'stress hardiness' traits (PCs) to 1) assess genetic variation among populations in stress hardiness as a function of seed-source climate, and 2) model geographic variation in stress hardiness across the Douglas-fir range. PC1 and PC2 explained 69 and 20% of the variation in the data, respectively. Higher PC1 values were indicative of greater drought resistance and cold hardiness, and correlated with cooler winter minimum temperatures of the seed-source climate. Higher PC2 values were indicative of greater drought resistance at the expense of cold hardiness, and correlated with greater summer aridity and fall maximum temperatures. In general, populations originating in mountainous regions with colder winter climates are well adapted to cope with both cold and drought stress, but climatic differences in summer and fall can confer relatively greater drought resistance or cold hardiness.

Spatial Portrait of the Wetland Restoration Effort in the Sacramento-San Joaquin Delta, California, USA.

Sophie Taddeo, Department of Landscape Architecture and Environmental Planning, University of California at Berkeley; Iryna Dronova, Department of Landscape Architecture and Environmental Planning, University of California at Berkeley.*

Ecological restoration is increasingly used to compensate for habitat loss and rehabilitate depleted ecosystem services, but has a variable level of success. Meeting restoration goals can be particularly challenging in heterogeneous and dynamic landscapes. A thorough understanding of landscape context is crucial in better targeting and prioritizing restoration efforts. The Sacramento-San Joaquin Delta of California is a prime case study to examine how landscape and restored ecosystems can interact. Major land transformations have significantly degraded ecological services historically provided by the Delta. In

response, considerable work has been applied toward the restoration of its impaired ecosystems. To characterize restoration efforts made to date and identify current gaps and future needs, we reviewed thirty wetland restoration projects implemented in the Delta between 1996 and 2014. We generated landscape statistics to describe spatial characteristics of these projects, their level of connectivity, and the composition of their adjacent matrix. One year of Landsat 8 images were then used to compare the phenological response of these wetlands with co-occurring historical or unmanaged marshes. Lastly, we compared the goals, restoration actions, and monitoring design within each project. Our results indicate that wetland restoration projects in the Delta are growing in size, number, and spatial complexity, but remaining relatively homogeneous in terms of goals and composition. The restoration effort is extremely clustered, leaving highly modified and urbanized portions of the Delta unaddressed. This research highlights the incidence of landscape dynamics on restoration success and demonstrates how a landscape perspective can be used to inform ecological restoration.

Impact of Landscape Planning on Land Use and Landscape Structure

Wolfgang Wende, Christian Stein, Ulrich Walz - Leibniz Institute of Ecological Urban and Regional Development, Dresden, Germany

Local landscape planning is the basis for realizing objectives of nature conservation at the level of land use planning. In this context it contributes to safeguarding the natural basis of life. Based on a representative random sample, this contribution will present the current nationwide state of local landscape planning in Germany.
There are major differences between the federal states, and peripheral rural municipalities have less often established a local landscape plan than urban municipalities. The effect of the implementation of local landscape plans on the development of certain land use types and landscape structures will be shown based on spatial data. For example, we found a weak correlation between the presence of a local landscape plan and the density of hedges and lines of trees. Municipalities with an implemented local landscape plan had less such linear landscape elements than municipalities without such a plan. Particularly in rural areas it is necessary to promote the instrument of landscape planning to allow for a closer cooperation of nature conservation and agriculture in view of the coming challenges, such as coordinating the greening of the EU agricultural policy, conserving biodiversity in general, adapting to climate change and increasing biomass production.

The concept of landscape services and its practical relevance

Olaf Bastian, Nature Conservation Authority; Karsten Grunewald, Ralf-Uwe Syrbe, Ulrich Walz - Leibniz-Institute of Ecological Urban and Regional Development (IOER)*

In addition to the concept of ecosystem services (ES), the term "landscape services" (LS) is becoming increasingly popular. We define LS as the contributions of landscapes and landscape elements to human well-being. We will examine the question of whether a stronger focus on LS would be justified and useful. Taking a literature review and own case studies into consideration, we stress important arguments for LS, e.g. their broader perspective beyond ecosystems (on landscape elements and the landscape character), the prominent role of spatial aspects, their stronger focus on the interplay between humans and environment, the more integrative view and interdisciplinary character of landscape (than of ecosystem), the relevance for landscape planning.
We don't argue for replacing ES by LS but for a situation-related use of both concepts and terms. We distinguish between three levels of relevance for using the term LS: 1. No or low - no considerable role of landscape issues, 2. Medium - landscape character or landscape units are crucial: both terms ES and

LS may be used, 3. The service ist not supplied by an ecosystem but by other landscape elements: the term LS should be used instead of ES.
The theoretical discourse will be underpinned and illustrated by case studies in an exemplary manner, concerning 1. the tourist attractiveness of landscape attributes (strong landscape context of aesthetics), 2. historical landscape elements (not all types are ecosystems), and 3. agri-environmental measures in a landscape plan (focus on landscape character and planning).

Biodiversity of oak forest in the eastern United States: regional and local importance for wildlife

Stephen Matthews, SENR Ohio State University; Louis Iverson, Northern Research Station USDA Forest Service; Matthew Peters, Northern Research Station USDA Forest Service; Anantha Prasad, Northern Research Station USDA Forest Service

Oaks (Quercus sp.) play a central role in the forests of the eastern United States and greatly influence the biodiversity of these systems. Many organisms relay on oak forests; ranging from direct food resources to the additional important habitat provisions of oak dominated forests. Contemporary changes in these systems thus can have direct impacts on vertebrate biodiversity. These challenges are magnified when viewed through the lens of persistent and emerging global change pressures. Working at two distinct resolutions, we provide an example of the ways in which vertebrate biodiversity are associated with oak species and their distributions. 1) At the distributional extent we have modeled 134 eastern US tree species habitats (including 27 oak species), and 147 bird species distributions and project how these species habitats may respond to climate change. Within the bird models we specifically include the potential for shifting climate and tree species habitats to quantify the strength of oak associations at the distribution extent. 2) At a finer resolution we consider how bird and salamander communities respond to differing degrees of forest management aimed to sustain oak regeneration. From these data we review and draw a link to the importance of oaks at two distinct resolutions and provide additional evidence to the importance of oak forests for biodiversity.

Patterns and predictors of spatial genetic structure within a coral reef fish metapopulation

Cassidy C. D'Aloia, Boston University; Steven M. Bogdanowicz, Cornell University; Richard G. Harrison, Cornell University; Peter M. Buston, Boston University*

Genetic connectivity is central to evolutionary processes within metapopulations, including fluctuations in effective population sizes, local adaptation, and divergence. While marine metapopulations were long-assumed to be connected across large spatial scales, recent applications of molecular genetics and spatial statistics have revealed restricted connectivity in many taxa. Here, we explore the potential mechanisms driving spatial genetic structure (SGS) in the Belizean metapopulation of the coral reef fish Elacatinus lori-a species with a well-described leptokurtic dispersal kernel. In this study, we (1) quantify patterns of SGS in the entire E. lori metapopulation, (2) identify bio-physical covariates of SGS, and (3) evaluate the extent to which genomic data increase the statistical power of empirical population genetic analyses relative to traditional microsatellite and mitochondrial markers. To describe SGS, we sampled intensively along the entire Belize barrier reef complex and applied a high-throughput multiplex approach to sequence ddRAD contigs, microsatellites, and mitochondrial markers. We then applied the seascape genetic analytical framework to disentangle the predictors of SGS by testing alternative hypothesis of isolation including distance, oceanographic distance, barriers, and environment. Taken together, these results will provide new insights into how dispersal kernels, seascape heterogeneity, environmental gradients, and ocean flow fields interact to drive intergenerational patterns of gene flow and emergent patterns of SGS.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Vulnerability of Coastal Cutthroat Trout to changes in stream temperature and flow in coastal streams of the Pacific Northwest of North America

Brooke E Penaluna, PNW Research Station, US Forest Service; Ivan Arismendi, Oregon State University; Steve Railsback, Lang Railsback and Associates; Bret Harvey, PSW Research Station, US Forest Service; Jason Dunham, USGS; Sherri Johnson, PNW Research St*

Climate change is affecting animals around the globe. Throughout the range of Coastal Cutthroat trout in western North America, observed climate trends have shown increases in occurrence of severe hot weather events, changes in precipitation, as well as decreases in frost days. As a consequence, stream temperature and flow are expected to become more variable and thus, increases the uncertainty related to how they will influence trout. Although streamflow is tightly coupled with stream temperature, they relationship could change into the future. Here, we use a scenario-neutral approach to evaluate the sensitivity of Coastal Cutthroat Trout (Oncorhynchus clarkii clarkii) populations to a plausible range of gradual changes expressed as separate and combined effects of stream temperature and flow. We use an individual-based model heavily parameterized with field data of geophysical template, trout abundance, and environmental regimes collected in Coastal streams of California and Oregon. The model tracks individual trout through daily processes of spawning, movement, feeding, growth, and mortality for six decades. Our results show that stream-trout persist with extreme changes in temperature and flow, but with seriously reduced biomass. Minimal changes to stream temperature and flow lead populations to maintain or increase biomass, but the window of resistance varies by stream. Our findings provide managers with enough information on trout responses to incorporate new climate change projections that may arise from new climate models when they are available.

Linking silvicultural and natural enemies hypotheses of forest insect outbreaks

Patrick James, Universite de Montreal*

Spatial interactions between insect parasitoids and their hosts influence spatial population dynamics and can have consequences for the spread and impact of invasive and pest insect species. These interactions involve processes across multiple scales and trophic levels that can vary in response to spatial and temporal context. Although studies have been undertaken in agricultural systems, relatively little is known about the role of landscape structure on these interactions and processes in forest ecosystems. In order to mitigate and manage the significant ecological and economic consequences of large-scale forest insect disturbances, we require a better understanding of how changes in forest landscape structure influence host-parasitoid interactions. In this talk I review the current understanding of the ways in which landscape structure affects the efficacy of natural enemies on forest pest species and how the combined effects of climate and land-use change may result in unprecedented outbreaks. In particular, I will discuss the indirect influence of landscape structure on top-down control through the long-discussed but seldom verified "silvicultural hypothesis" of forest insect outbreaks. Finally, I will also present recent research into the spatial environmental determinants of parasitoid abundance, diversity, and efficacy in eastern boreal regions being affected by an ongoing outbreak of spruce budworm.

Telecoupling in Urban Water Systems: An Examination of Beijing's Imported Water Supply

Jillian M. Deines, Center for Systems Integration and Sustainability, Department of Geological Sciences, Michigan State University, East Lansing, USA; Xiao Liu, 2Department of Geological Sciences, Michigan State University, East Lansing, USA; Jianguo Liu,

Urban centers increasingly have difficulties meeting water needs within their hydrologic basins. The resulting flows among cities and water source regions lead to telecouplings (socioeconomic and

environmental interactions over distances). To analyse these interactions, we apply the emerging telecoupling framework to the following telecouplings in the water-stressed megacity of Beijing: 1) interbasin water transfers; 2) virtual water imports; and 3) payments for ecosystem services to upstream regions to increase water quantity and quality. Through literature review and synthesis, we find that these telecouplings have lower overall risk than Beijing's local supply, but connections affect remote sending systems. Virtual water imports contribute over half of Beijing's water footprint, and anticipated interbasin water transfers will increase 2020 physical water availability by 43% compared to the 2001-2011 mean. Payments for ecosystem services improved water quality and were extremely cost effective, but they contributed minimally to water quantity. The telecoupling framework provides a standard, systematic, and flexible tool for evaluating the sustainability of urban water supply. It also identifies a number of research gaps for future quantification efforts.

The Influence of Vegetation Height Heterogeneity on Forest and Woodland Bird Species Richness across the United States

Qiongyu Huang,Department of Geographical Sciences, University of Maryland at College Park; Anu Swatantran, Department of Geographical Sciences, University of Maryland at College Park; Ralph Dubayah, Department of Geographical Sciences, University of M*

Avian diversity is under increasing pressures. It is thus critical to understand the ecological variables that contribute to large scale spatial distribution of avian species diversity. Traditionally, studies have relied primarily on two-dimensional habitat structure to model broad scale species richness. Vegetation vertical structure is increasingly used at local scales. However, the spatial arrangement of vegetation height has never been taken into consideration. Our goal was to examine the efficacies of three-dimensional forest structure, particularly the spatial heterogeneity of vegetation height in improving avian richness models across forested ecoregions in the U.S. We developed novel habitat metrics to characterize the spatial arrangement of vegetation height using the National Biomass and Carbon Dataset for the year 2000 (NBCD). The height-structured metrics were compared with other habitat metrics for statistical association with richness of three forest breeding bird guilds across Breeding Bird Survey (BBS) routes: a broadly grouped woodland guild, and two forest breeding guilds with preferences for forest edge and for interior forest. Parametric and non-parametric models were built to examine the improvement of predictability. Our results suggest that height heterogeneity, beyond canopy height alone, supplements habitat characterization and richness models of forest bird species. The metrics and models derived in this study demonstrate practical examples of utilizing three-dimensional vegetation data for improved characterization of spatial patterns in species richness.

Integrated multidirectional hydrological connectivity in riverine and non-riverine freshwater conservation planning in North China Plain

Xiaowen Li, State Key Laboratory of Water Environment Simulation, Environmental School, Beijing Normal University; Tiantian Ma, Environmental School, Beijing Normal University*

Freshwater ecosystem has received an increasing attention due to its globally continuing decline, but it mostly protected within terrestrial conservation framework, lacking of specific conservation framework and tool. We therefore explored an freshwater specific conservation strategy demonstrated by a case in North China Plain(4.84Ã—106 km2), where the freshwater ecosystem is composed by a large area of interbasin floodplains of three large rivers in North China (i.e. Yellowing river, Huaihe River and Haihe river. Our conservation strategy highlighted the fundamental difference between freshwater and terrestrial ecosystemt in that: 1) integrate riverine and nonriverine wetlands into conservation assessment to maintain their interdependence probablly undermined by prevailing separate

assessment, 2) integrate multidirectioanl hydrological connectivity, i.e. longitudinal(upstream-downstream), lateral(riveine-floodplain) and vertical(surface water-groundwater) connectivity into conservation targets to address inherent connect nature of freshwater ecosystem; 3) incorporate artificial freshwater targets to accommodate the interbasin conservation needs of ongoing world largest water project on North China Plain, i.e. South-to-North Water Diversion Project. We developed this freshwater specific conservation strategy by innovatively applying approaches well developed for terrestrial ecosystems, e.g. systematic conservation planning and its tool-Marxan. Key outputs included existing conservation gaps, proposed conservation targets and irreplacebility conservation pattern of freshwater ecosystem based on different conservation strategy. Our novel approach and conservation strategy enables managers to set ecologically meaningful spatial conservation priorities for freshwater ecosystem in North China Plain.

An Urban Rat Race: Using Landscape Genetics to Inform Epidemiology in Salvador, Brasil

Jonathan Richardson, Providence College; Federico Costa, Oswaldo Cruz Foundation/Salvador Ministry of Health; Christian Hernandez, Yale University; Mary Burak, Providence College; Albert Ko, Yale University; James Childs, Yale University; Adalgisa C

The last half-century has seen a sharp transition in human population densities, as more than half the world's population now lives in urban areas. This pattern is even more dramatic in developing countries, and has distinct and important consequences for landscape dynamics. Salvador, Brasil is a large city of three million residents that has experienced a 280% increase in its population since 1970. Much of this added population is concentrated in slum settlements, known as favelas, that are characterized by refuse piles, open sewage and overgrown vegetation. These conditions promote rodent infestations, particularly the Norway rat (Rattus norvegicus) - a reservoir host for the zoonotic pathogen that causes leptospirosis. Leptospirosis outbreaks occur each year in favelas during the wet season, and millions of dollars are spent annually on public health campaigns designed to eradicate the Norway rat vector. In order to target eradication efforts, epidemiologists and public health officials have requested information on the areas where rats are moving between suitable slum habitats. We estimated the amount of gene flow occurring within and across seven favela communities in Salvador for >600 Norway rats trapped over 5 years. We used a landscape genetics approach to characterize the role that the local and neighborhood landscape plays in shaping the gene flow among rat sampling locations, including topography, trash disposal and socioeconomic measures. This information will be used to target future eradication strategies by local public health authorities in Salvador.

Assessing how environmental heterogeneity influences functional connectivity: Towards behavioral landscape genetics

Femke J Pflueger, Niko Balkenhol - University of Goettingen, Department of Wildlife Sciences*

Understanding the causes and consequences of functional connectivity is crucial for many fundamental research questions in ecology, evolution, and conservation. For populations, a particularly important aspect of connectivity is the exchange of migrants and genes, which occurs if organisms successfully move from one location to another, and subsequently reproduce at the new location. Landscape genetics has tremendous potential for enhancing our understanding about landscape effects on this effective dispersal. However, the vast majority of landscape genetic studies focuses on effects of the landscape among sampling locations on dispersal (i.e., matrix quality), while effects of local environmental conditions (including patch size, habitat type, or resource availability) are rather neglected. We will outline how environmental heterogeneity can influence the different stages of the dispersal process: emigration out of the current location, transience through the landscape, and

immigration into a new location. At each stage, individuals base their dispersal decisions on expected fitness costs and benefits that are affected by environmental conditions found at the current and the future location, and by the resistance of the landscape between locations. In our opinion, landscape genetic studies would greatly benefit from simultaneously incorporating both matrix quality and local environmental conditions when assessing landscape effects on effective dispersal. In sum, we think it is timely to move beyond purely statistical, pattern-oriented analyses in landscape genetics, and towards process-oriented approaches that consider the full range of possible landscape effects on dispersal behavior and resulting gene flow.

The spread of deciduous shrubs in the Arctic: Sex or no sex?

David A. Watts, Ecology and Department of Biology, The Pennsylvania State University, USA; Vladimir Douhovnikoff, Department of Biology, Bowdoin College, USA; Eric S. Post, Department of Biology, Pennsylvania State University, USA

The rapidity of recent warming in the Arctic has led to pronounced localized changes in vegetation, and experimental and observational studies have shown the expansion of shrubs to be strongly associated with this warming trend. Multiple biophysical mechanisms behind this expansion have been explored, but the biological means by which shrubs increase in cover on landscapes is poorly understood. Although these plants can increase in abundance through sexual recruitment as well as asexual growth and spread, the relative contribution of these two distinctive modes to the expansion of shrubs remains unknown. The primary goal of this study was to assess reproduction in the deciduous shrub Salix glauca along an 11 Â°C summer and -20 Â°C winter climatic gradient from coastal maritime to inland continental sites in West Greenland. We used microsatellite markers to genotype neighboring stems (ramets) to delineate genetically distinct individuals (genets) at scales relevant to shrub expansion in locations with apparent recent increases in shrub cover. We are thus able to infer the proportion of shrubs derived from clonal expansion versus sexual reproduction. A higher proportion of sexual recruits in sites with continental climates would suggest that summer establishment is more limiting, whereas the converse pattern would suggest that winter survivorship more strongly regulates the establishment of new individuals. Results from this study are germane to where expansion of S. glauca is likely to occur as well as the genetic diversity of present and future populations.

Identification of landscape corridors with the help of a new, graph-theory based, approach integrating functional connectivity and landscape configuration metrics

Jerzy Solon, Institute of Geography and Spatial Organisation PAS; Wojciech Pomianowski, Institute of Geography and Spatial Oganisation PAS*

Because of changes in official regulations there was a need to re-identify in a more detailed way ecological corridors linking nature protection sites. The research was carried out in north-eastern Poland, and included two tasks. First was focused on modeling landscape corridors for game mammals on the area of 15000 sq. km, with the input data derived from the Corine Land Cover map. Second task was conducted on a smaller site (c.a. 500 sq. km), of the Wigry National Park and its vicinity, located in the central part of the whole area. Input data were derived from the map of actual vegetation, and corridors were modeled not only for game mammals but also for amphibians. The approach of identifying corridors was based on the analysis of the full graph derived from a vector map of landscape mosaics. The core idea was to identify the path with the minimal sum of resistances of patches and borders to be crossed (weighted minimum spanning tree - MSP). Three categories of resistances were incorporated to modify the MSP: (a) Patch class resistance (patch suitability for a given species/process); (b) Resistance of a patch-to-patch transfer (structural/ecological similarity of adjacent patches); (c)

Resistance of the patch size/shape (based on a preferred metrics of patch size/shape). Manipulation with values of patch class and transfer resistances, as well as differences in spatial ant thematic resolution of input data resulted in obtaining a bunch of similar but not identical routes which together better represent functional connectivity between patches.

Seeing the forest for the trees: Is there a place for individual trees in forest landscape modeling?

Rupert Seidl, University of Natural Resources and Life Sciences (BOKU) Vienna, Austria*

As a result of technological advances computational constraints are a less important for model development today than they were one or two decades ago. The exponential increase in computational capacities enables us to address larger landscapes at higher resolution, run more replicates, and include new processes and entities explicitly in our simulations. Decisions about resolution and scale should, however, be primarily made with regard to the respective research question to be addressed with a model. Here I will ask whether there is scientific value in simulating forest landscapes at the resolution of individual trees. In the context of landscape ecology under global change, and based on my experience with the individual-based forest landscape and disturbance model iLand, I will present three examples of how high resolution landscape models can contribute to current ecological questions. I will address (i) the role of diversity in ecosystem functioning, (ii) the search for resilience in forest landscapes, and (iii) the prediction of disturbance impacts on ecosystems. Notwithstanding the enduring value of community- and cohort-based approaches in landscape modeling I conclude that the concurrent development and application of individual-based models can broaden the range of applications of forest landscape modeling.

Introducing the Participatory scenario Storyline and Visualisation method (PsSV), exemplified via analyses of N management strategies in 6 Danish agricultural landscapes.

Morten Graversgaard, Chris Kjeldsen, Tommy Dalgaard -Department of Agroecology, Aarhus University; Peter StubkjÃ¦r Andersen, Andreas Aagaard Christensen, Henrik Vejre -Department of Geosciences and Natural Resource Management. University of Copenhagen; L*

In Denmark nitrogen (N) policies has been implemented since the 1980s, with significant effects on N surplus, environmental loadings of N and on the management strategies applied in agricultural landscapes. However the N losses from land to waters and the surrounding seas are still beyond the targets set out in legislation. To further improve the quality of waters and to reduce the nutrient losses to ecosystems, new participatory methods addressing the N cascade, needs to be developed with key stakeholders.
In 6 different landscape pilot areas within the Danish research alliance (www.dNmark.org), a new Participatory scenario Storyline and Visualisation method (PsSV) has been tested. The PsSV is a stakeholder engagement and workshop method that facilitates a process of developing geographical targeted solutions with multiple stakeholders. The method uses local knowledge about agricultural landscapes and farming practices to create qualitative scenarios together with the stakeholders. The scenarios are subsequently translated into a set of quantified parameters that are used as input for an N- flow model and a participatory GIS visualization landscape modelling framework.
The method has shown the following preliminary results: By using stakeholders' local knowledge and understanding of landscapes, specific geographical solutions have been the outcome of workshops. Furthermore, the method allows for integration of knowledge between local citizens, farmers, policy makers and researchers, which has given valuable input for regulatory alternatives to the current top-down water management in Denmark. The method can be applied to other environmental problems, where knowledge about the landscape is essential to sustainable solutions.

Landscape Effects on the Biodiversity of Birds and Predatory Arthropods in Soybean Agroecosystems

Valerie E. Peters, Biology, Miami University; Amelie Y. Davis, Geography, Miami University; Alberic Ponce de Leon, Universidad de Puerto Rico; Thomas O. Crist, Biology, Miami University*

Biodiversity studies in agricultural lands have shown that landscape-scale patterns of land cover influence the diversity and abundance of birds and arthropods that are important ecosystem service providers. Most studies to date, however, focus on the amounts of natural land cover and do not consider the land-cover heterogeneity of crop areas. We studied the roles of configurational heterogeneity and the amount of natural land cover in determining the diversity and abundance of arthropod and bird natural enemies in soybean agroecosystems of SW Ohio. To test the effect of configurational heterogeneity, we pre-selected 3km radius landscapes with overall high crop cover (~60-80%) and sorted them into two groups of four landscapes: (1) high (14-20ha) and (2) low (9-10ha) mean patch area of crop cover types. We also determined the amount of forest cover in each landscape. Birds and arthropods were sampled near the edge (10m) and interior (100m) of soybean fields. Birds were slightly more abundant in landscapes with low mean patch area whereas bird species richness was greatest at edges between fencerows and crops. Forest cover showed a weak positive effect on bird richness and abundance. Predatory arthropods responded positively to increases in forest cover and were more abundant on field edges in landscapes with high mean patch area. Our results suggest that both birds and predatory arthropods responded positively to greater landscape configuration but predatory arthropods were more sensitive to variation in the amount of natural cover compared to birds.

Conclusion

Ulrich Walz, Leibniz Institute of Ecological Urban and Regional Development; Christian Stein, Leibniz Institute of Ecological Urban and Regional Development*

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Farmer attitudes and behaviours regarding the restoration of woody vegetation on intensive pastoral dairy farms

Dr. Yuki Fukuda, Otago University Dr. Wendy McWilliam, Lincoln University Dr. Henrik Moller, Ecosystem Consultants*

Woody vegetation networks in intensive agricultural landscapes provide many public ecosystem services, including mitigation of farming environmental impacts (e.g. Parkyn et al. 2003); however many are small, fragmented and degraded (e.g. Norton and Miller, 2000). However, their establishment can result in reduced farm productivity, and are costly to establish and maintain (e.g. Rhodes et al. 2002). Countries with neo-liberal political systems, rely on farmers to voluntarily plant networks, and supporters argue farmers are the landowners and decision makers regarding landscape change. However, little is known about farmer attitudes and behaviours regarding network restoration, or the effectiveness of voluntary policies (Edling 2003). Using New Zealand dairy farms as a case study, a questionnaire determines what, where and why farmers plant, and the effectiveness of voluntary policy approaches. Preliminary results indicate many farmers have removed components such as the shelterbelts, and are planting relatively small riparian and wetland areas to provide public ecosystem services such as water cleansing and nature conservation. However, many farmers are not planting due to a lack of sufficient private ecosystem services. Few farmers take advantage of government incentive

programs, and while half indicate sufficient incentives would motivate them to plant, the other half indicate incentives would not influence their decision making. Recommendations for improved approaches for encouraging woody vegetation networks retention and restoration are provided.

High Performance Computational Landscape Ecology

Forrest M. Hoffman, Oak Ridge National Laboratory; William W. Hargrove, USDA-Forest Service Eastern Forest Environmental Threat Assessment Center; Jitendra Kumar, Oak Ridge National Laboratory; Zachary L. Langford, University of Tennessee-Knoxville

Rapid technological advances in sensor development, computational capacity, and data storage density have driven an equally rapid increase in the volume, complexity, and resolution of Earth science data. Combining, integrating, and synthesizing these data pose new computational challenges while also offering new opportunities for scientific discovery that are only beginning to be realized. Disparate multi-scale, multi-sensor in situ and remote sensing time series data are being collected to understand the structure and function of ecosystems and how they may be affected by climate change. However, resource and logistical constraints limit the frequency and extent of in situ observations, particularly in the harsh environments of the arctic and the tropics, necessitating the development of a systematic sampling strategy to maximize coverage and objectively represent variability at desired scales. These regions host large areas of potentially vulnerable ecosystems that are poorly represented in Earth system models, motivating two new field campaigns, called Next Generation Ecosystem Experiments (NGEE) for the Arctic and Tropics, funded by the U.S. Department of Energy. Here, we present the use of high performance computing for a variety of ecological applications employing Multivariate Spatio-Temporal Clustering (MSTC), a quantitative methodology for defining ecoregions and climatic states, stratifying sampling domains, determining the representativeness of measurement sites and networks, and extrapolating sparse measurements to the landscape scale using spatially gridded surrogate variables. Also presented are approaches for designing large-scale ecological analytical algorithms and considerations for utilizing the next generation of supercomputers for the burgeoning discipline of computational landscape ecology.

Evaluating pattern and processes of cultural landscape dynamics in Europe

Matthias Burgi, Swiss Federal Research Insitute WSL, Switzerland; Anu Printsmann, Tallinn University, Estonia; Juraj LieskovskÃ½, Institute of Landscape Ecology SAS, Nitra, Slovakia*

Cultural landscapes are shaped by the interaction between natural and societal forces. We present a comparative approach assessing landscape dynamics in selected municipalities across Europe, i.e. Borje (Sweden), Lenk (Switzerland), Colmenar Viejo (Spain), Modbury (GB), Plomari and Gera (Greece), Alatskivi and Peipsiaare (Estonia), Dineault (France). The central aims of the study are to reconstruct the landscape dynamics (change and persistence) of the past 100 to 150 years in selected European cultural landscapes and to provide comparative insights on the role of contextual factors, driving forces, and local actors for landscape dynamics. Based on a common map legend, historical topographical maps and aerial images are digitized and the major changes and persistence are listed. To have a background information on driving forces of changes as well as of persistence, the information from secondary literature, local experts knowledge and statistical sources are used. Further insight into the locally perceived driving forces of changes and persistence are given by the oral history interviews with long-term residents of the study municipalities.

Spatio-temporal variation of biotic factors underpins contemporary range dynamics of congeneric species

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

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Evaluating the process of the integration of cultural landscape values in landscape ecological management

Stephanie Verplaetse, Department of Geography, Faculty of Science, Ghent University, Belgium; Wouter Gheyle, Department of Archaeology, Faculty of Arts and Philosophy, Ghent University; Ignace Bourgeois, Province of Antwerp, Department of Culture; Rebekk*

The commemoration of the First World War induced attention in academic research, policy-making and public awareness, which has led to a boom of initiatives, including landscape research. In order to formulate landscape quality objectives considering heritage values of World War I features and their surrounding cultural landscape, the province of Antwerp (Belgium) initiated a series of transdisciplinary research projects. In a first phase, an archaeological inventory of the preserved war traces was made as well as a landscape characterization analysis addressing the historical and visual aspects. The second step focused on a strategy for future management of the cultural landscape build around two strategic objectives: (1) preservation and protection, and (2) providing access to the military and landscape heritage. Finally design proposals to preserve and access the heritage in different landscape contexts were developed and put into practice in the management plan of a nature conservation area. The aim of this paper is to evaluate the transdisciplinary process of the projects. We will first illustrate how nature conservation management took into account the military heritage values. Second, for each step in the overall project, the organization and project design are analyzed and evaluated to assess the process of integration between different disciplines, the provincial commissioners and the involvement of local authorities and NGOs. The paper will demonstrate that the scientific outputs are mainly based on expert knowledge, while the formulation of objectives, design proposals and management implementations were only successful when including an active involvement of the different stakeholders.

Vegetation and topsoil characteristics and their importance in interception and infiltration in drainage systems under cocoa plantations, Itacare, Bahia, Brazil.

Paulo Vagner Ribeiro da Silva, Estate University of Santa Cruz; Thiara Helena Mota Almeida, Estate University of Santa Cruz; Paulo Fernando Meliani, Estate University of Santa Cruz: Andre Batista de Negreiros, Federal University of SÃ£o JoÃ£o del Rei

This study focuses on the tropical rainforest, located near to Atlantic Ocean coast in the State of Bahia, Brazil. The forest management associated with Theobroma cacao agriculture (Cabruca system) has a important role in forest conservancy. Conservation of the surrounding forest is achieved through the main hydrological functions of cocoa agriculture, such as redistribution of water into the soil. To understand the effects and geohydroecologic responses of this management, we chose two areas in the Jeribucassu River basin in region of Itacare in Bahia, one with cultivated cabruca and another with tropical rainforest, in three different topographic locations. We conducted examinations in order to understand and describe the vegetation structure through parameters such as basal area, diameter breast height (DBH), shaft, existence of dead trees, litter, topsoil and geomorphological characterization. We conclude that the successional differences between the studied domains are anthropogenically influenced in cabruca by thinning of the understory, or natural facts which influence in arboreal development process in both domains. In the litter layer where leaves decompose, ecological disturbances in the cabruca area directly influence the amount found. In the topsoil, it was possible to define textural classes. In spite of the differences found in the different domains, this study confirmed

the need for conservancy through cabruca systems, considering its importance to the regional economy as well as rainforest preservation.

Detecting and Tracking Shifts in National Vegetation Composition Across the MODIS Era

Jitendra Kumar, Oak Ridge National Laboratory; William W. Hargrove, USDA Forest Service; Forrest M. Hoffman, Oak Ridge National Laboratory; Steve Norman, USDA Forest Service; Nathan Collier, Oak Ridge National Laboratory;*

Forested landscapes are ecologically and economically important, and understanding their dynamics is important for land--management decision making. Forest ecosystems are also under stress, and may be changing due to interannual variability and long term change in climate, natural and anthropogenic disturbance, including human use and management. Detecting and tracking shifts in vegetation is important for land--management, conservation planning, monitoring recovery, managing and monitoring forest structure and composition, maintaining species and habitat diversity and many other purposes. We used MODIS NDVI to create phenological ecoregions, or "phenoregions" having similar annual phenology using a unsupervised clustering method over the period 2000--2012. These statistically derived phenoregions were reclassified to National Land Cover Database (NLCD) classes using the "Mapcurves" algorithm. Interannual transitions in phenologically defined classes are indicator of disturbance and recovery. Because the area within the CONUS is fixed, land cover area changes are a zero-sum game. Changes in one land cover class must be accompained by compensating changes in other classes. We demonstrate a full-circle national-scale accounting system which can track not only area changes in land cover classes, but can show which other compensatory land cover class area changes accompanied them. Area changes in the vegetation distributions, as well as compensatory gains, losses, and trades in area of other land cover types, were mapped and tracked annually during 2000--2012 period at MODIS resolution. The types or labels of the classes used in the accounting can easily be changed to sets of land cover types that maximize the utility of the tracking. For any particular "focus" land cover type, results show which other land covers were donors or recipients of area changes, showing ecologists and land managers alike what vegetation types were given up or gained to offset particular increases or losses. Large volumes of MODIS NDVI time series data at continental scale poses a computational challenge. We will also present large scale data analytic strategies to exploit parallelism in the problem to deliver computationally efficient solution in a high performance computing environment.

Ecological legacies of pre-Columbian raised fields in French Guiana

Delphine Renard, Department of Natural Resources McGill University; Anne Zangerle, Centre d'Ecologie Fonctionnelle et Evolutive UMR 5175 CNRS France; Stephen Rostain, Archeologie des Ameriques UMR 8096 CNRS France; Bruno Glaser, Department of Soil Physic*

Some South American wetlands bear impressive legacies of pre-Columbian raised fields, constructed to permit agriculture in seasonally flooded environments. Almost a millennium after abandonment, their vestiges still persist. We apply an interdisciplinary approach aimed at understanding how past land use influences how these ecosystems function today. In a raised-field landscape of the Guiana coast, we characterized the diversity and distribution of soil macroinvertebrates (ants, termites, earthworms) and plant roots within the landscape and quantified their influence on soil physical properties. Our results showed that landscape modification by pre-Columbian farmers has long-lasting effects on the distribution of soil organisms. Since their abandonment, and probably before, raised fields have attracted a diverse and abundant community of soil engineers that enhance the stability of mound soils, allowing their maintenance against erosion. However, the strength of these positive feedbacks varies

with drainage conditions and soil texture, both of which are determined by landscape topography. As a result, the ability of soil engineers to maintain ancient raised fields varies over the landscape. Archaeology offers examples of pathways to agricultural intensification that integrated soil engineers. These could be rich sources of inspiration for designing agricultural landscapes that could reconcile food production, ecosystem services and biodiversity.

Warfare as a(nother) trigger for regime shifts in land-use systems: The Case of Nagorno-Karabakh

Matthias Baumann, Humboldt-University Berlin; Volker C. Radeloff, University of Wisconsin-Madison; Vahagn Avedian, Lund University; Tobias Kuemmerle, Humboldt-University Berlin*

Socio-economic shocks can shape land-use trajectories, and armed conflicts are an extreme form of a socio-economic shock. However, the effects of armed conflicts on land-use systems are largely unclear. Our goal was to assess how an armed conflict can affect land-use systems by taking the Nagorno-Karabakh conflict in the Caucasus between 1991 and 1994 as an example. The conflict between Armenia and Azerbaijan was characterized by heavy military action and more than 1 million refugees. Using a combination of Landsat satellite image classification and matching statistics, we found that (a) land-use changes in conflict areas were dominated by high rates of farmland abandonment (up to 60%), (b) the conflict triggered substantial displacement of agricultural activities to nearby Azerbaijani territories, and (c) 20 years after the conflict many of the land-use changes from the conflict period did not revert. Our results thus suggest, that the Nagorno-Karabakh conflict resulted in a deep transformation of the region's land-use system, with decreasing land-use intensity in the local conflict areas, and increasing intensity in areas afar. The armed conflict may therefore represent an example of a shock event triggering a transition of land-use systems into a new, possibly stable, state, akin to other drastic socio-economic shocks.

Thresholds responses and policy punctuation shape regime shifts in Southeast Asian land systems

Daniel Muller Leibniz Institute of Agricultural Development in Transition Economies (IAMO), Theodor-Lieser-Str. 2, 06120 Halle (Saale), Germany Integrative Research Institute on Transformations of Human-Environment Systems (IRI THESys), Humboldt-Universi*

Land systems often undergo periods of nonlinear and abrupt change that invalidate future predictions calibrated on past trends. Rapid land-system change can occur when critical thresholds in broad-scale underlying drivers such as commodity prices and climate conditions are crossed or when sudden events such as political change or natural disasters punctuate long-term equilibria. As a result, land systems can shift to new regimes with markedly different economic and ecological characteristics. We demonstrate the difficulty of anticipating regime shifts of land systems through empirical case studies in four countries in Southeast Asia (China, Laos, Vietnam and Indonesia). The results show how sudden events and gradual changes in underlying drivers caused rapid, surprising and widespread land-system changes, including shifts to different regimes in China, Vietnam and Indonesia, whereas land systems in Laos remained stable in the study period but show recent signs of rapid change. Timing and nature of the observed regime shifts were difficult to anticipate, which compromises the validity of predictions of land-system changes and their effects on ecosystem services and biodiversity. This implies that long-term initiatives such as REDD must account for the substantial uncertainties inherent in future predictions of land-system change. Learning from past regime shifts and identifying early warning signs for future regime shifts are important challenges for land-system science.

Successes and Challenges from Formation to Implementation of Eleven Broad-extent Conservation Programs

Brady Mattsson, University of Natural Resources and Life Science - Vienna; Erik Beever, Matthew Germino, Max Post Van Der Burg, John Bradford - U.S. Geological Survey; Mark Brunson, Utah State University*

Integration of conservation partnerships across geographic, biological, and administrative boundaries is increasingly relevant because drivers of change, such as climate shifts, transcend these boundaries. We explored successes and challenges of established conservation programs that span multiple watersheds and consider both social and ecological concerns. We asked representatives from a diverse set of 11 broad-extent conservation partnerships in 29 countries 17 questions that pertained to launching and maintaining partnerships for broad-extent conservation, specifying ultimate management objectives, and implementation and learning. Partnerships invested more funds in implementing conservation actions than any other aspect of conservation, and a program's context (geographic extent, United States vs. other countries, developed vs. developing nation) appeared to substantially affect program approach. Despite early successes of these organizations and benefits of broad-extent conservation, specific challenges related to uncertainties in scaling up information and to coordination in the face of diverse partner governance structures, conflicting objectives, and vast uncertainties regarding future system dynamics hindered long-term success, as demonstrated by the focal organizations. Engaging stakeholders, developing conservation measures, and implementing adaptive management were dominant challenges. We describe an approach to overcome these challenges using two case studies on large, cross-border national parks of central Europe.

Forest Landscape Models-Where Is the State of the Art?

Hong S. He, School of Natural Resources, University of Missouri; Wen J. Wang, School of Natural Resources, University of Missouri; Frank R. Thompson, USDA Forest Service Northern Research Station; Jacob S. Fraser, School of Natural Resources, University*

Forest landscapes are expected to change as a result of site-scale processes (succession and competition), landscape-scale processes (dispersal, disturbance, and management), and regional-scale processes (climate change). The interactions of these processes are complex, which makes forest landscape models (FLM) indispensable in predicting the outcome of these processes across spatial and time. FLMs vary greatly in tracking fundamental information at the site-scale (e.g., individual tree, species functional group, biomass by age cohort, tree density by size), and consequently ecological design and applications of these models. For the past decade, FLMs have increased in model complexity and simulation capacity as a consequence of theoretical and technological advances. Increasing complexity of representation and formulation of site scale processes has improved the realism of the simulated landscape dynamics, whereas tradeoff between model complexity and simulation capacity still exists for FLM applications to be meaningful. Many FLMs have achieved a new capacity of regional-scale predictions by incorporating additional site- and landscape-scale processes. Such predictions allow for comparisons with those by niche models to reveal the effects of dispersal, disturbance and management, thus further reducing prediction uncertainties under changing climate conditions. This presentation discusses 1) new developments in FLMs particularly in the area of integrating stand dynamic in succession, disturbance, and management, 2) utilizing the best available data-data assimilation (DA), 3) frameworks for evaluating (validating) model predictions, and 4) challenges and future directions of FLMs.

Effects of contemporary wildfires on structural variation and landscape diversity in forest of the Pacific Northwest

Matthew J. Reilly, Oregon State University; Thomas A. Spies, USDA Forest Service Pacific Northwest Research Station*

Fire exclusion and forest harvesting during the 20th century are hypothesized to have reduced structural variation and decreased landscape diversity across the Pacific Northwest. Despite concern regarding the return of wildfire to these forests, little is known regarding the magnitude of their effects on structural variation and landscape diversity at the regional scale. We use data from over 11,000 forest inventory plots from Oregon, Washington, and northern California to develop a structural classification of forest vegetation based on stand level attributes describing live trees, snags, dead and downed wood, and understory vegetation. We compare the range of structural variation and abundance of classified structural types among potential vegetation zones in the Pacific Northwest. Differences in structural variation among vegetation zones corresponded with dominant climatic gradients and recent wildfire occurrence, but there was still a high degree of similarity among some wet and dry vegetation zones composed primarily of moderate and high biomass structural types with high density. The effect of wildfires on structural variation was most evident in dry forests where they have primarily decreased tree density and increased mean tree size. Diverse early successional structural types with dead biological legacies were rare and associated with wildfires, but their abundance differed tremendously among vegetation zones. Recent wildfires have evidently increased structural variation and landscape diversity in some vegetation zones of the region where they have potentially increased resilience to future drought and wildfire by restoring some aspects of historical stand structure and landscape composition.

Exploring the pattern of residential environment characteristics in Beijing

Yuyang Bao, Beijing Normal University; Ganlin Huang*, Beijing Normal University.*

A livable residential community needs to be safe, convenient, socially and environmentally friendly. In Beijing, the capital of China, exist over 2,600 communities with very different established times. In order to get the pattern of the residential environment characteristics in Beijing, we randomly chose 16 communities in each of the five administrative regions within the Fourth Ring to be the research area. Detailed aspects of safety, convenience, social capital and environmental characteristics were organized into questionnaires, which were filled by researchers during site surveys. We carried out a site survey for each chosen community. After analyzing via GIS, we got a preliminary knowledge of the residential features in Beijing. Older communities tend to enjoy more green space and active social network, but they are not as safe as most of the newly-built communities. As for life convenience, communities in more developed areas seem to score higher. Locations and distances to main road also have obvious effects on convenience. This research will give some help to city designers to understand the needs of the residents better and to locate civil facilities wisely.

Specialist parasitoids in urban and agricultural landcover: a metacommunity approach

Amanda E. Nelson, Andrew A. Forbes -University of Iowa Department of Biology*

In the Midwestern US, forested and other woody plant habitats are embedded in a matrix of agricultural and urban landcover that alters configurations of "natural" habitats and creates novel habitat types. Variation in the type and juxtaposition of landcover in the matrix between habitats can profoundly impact the spatial and temporal distributions of insects. Parasitoid wasps are predicted to be prone to local extinction in response to increased habitat fragmentation, but often respond differently to similar landcover contexts. Understanding and predicting idiosyncratic spatial population dynamics of parasitoids and other insect species requires integration of metacommunity-level ecological paradigms

with spatial analyses across multiple spatial scales. Specialist herbivores and parasitoids that depend on discrete plant habitats simplify assessment of how trophic interactions, local demographic traits, and dispersal processes affect responses to landcover heterogeneity. We carried out a multi-year study measuring rates of site occupancy, herbivory, parasitism, and, for some taxa, gene flow, for two specialist host tree-herbivore-parasitoid systems in an agricultural and urban Southeast Iowa study area. We analyzed impacts of landcover composition and heterogeneity on intra- and inter-specific spatial dynamics across a range of spatial scales. Results show that, despite increased density of urban host trees relative to agricultural, urban herbivory and parasitism rates are depressed-to the point of urban extirpation for one parasitoid. Further, results indicate that agricultural versus urban landcover contexts can mediate distinct spatial population structuring across linked trophic levels.

Participatory approach to biodiversity conservation in rural poor communities: challenges and opportunities in tropical landscapes

Akomian Fortune Azihou, Laboratory of Applied Ecology, University of Abomey-Calavi, Benin; Ronald Bellefontaine, CIRAD-Bios, UMR 1334 AGAP, F-34398 Montpellier Cedex 5, France; Rosie Trevelyan, Department of Zoology, Cambridge CB2 3EJ, UK ; Brice Sinsin,L

Gallery forests are unique habitat for many endangered plant species. In villages surrounding the Biosphere Reserve of Pendjari, the free access to these community forests results in the unsustainable harvesting of resources. Through a participatory approach, this study aimed to assess ecosystem services provided by gallery forests; evaluate local conservation strategies; and assess the gap between field data and local knowledge on regeneration methods used by five threatened tree species. Ethnobotanical survey of 100 households was undertaken in 5 villages on Afzelia africana, Daniellia oliveri, Khaya senegalensis, Pterocarpus erinaceus and Vitex doniana. Twenty delegates from interviewed households were organised on working groups to record regeneration data on 10 sampled mother trees per species in each village. The results of the ethnobotanical survey showed that gallery forest ecosystems provided food, fodder, traditional medicine and rituals, honey hunting, brick and vegetable production to local communities. Targeted species were scarce in agroforestry systems. Regeneration by seeds and coppicing were recorded as propagation methods of all targeted species. Root suckering was used by Daniellia oliveri and Vitex doniana. Field work with farmers revealed that all targeted species regenerate by true seedlings except Vitex doniana. Seedlings sprouts were commonly recorded for the five targeted species. Regeneration by root sprouts was also common for Vitex doniana and Daniellia oliveri and rare for Khaya senegalensis. Interestingly, farmer field school provide the opportunity to observe root sprouts of Afzelia africana and water sprouts of the five targeted species. This study discussed collaboration between landscape ecologists and local communities.

Canopy gap measurements in past and present: new prospects for forest science

Dominik Seidel, Department of Forest Ecosystems and Society, Oregon State University; Klaus Puettmann, Department of Forest Ecosystems and Society, Oregon State University

Canopy gaps are an important component in forested landscapes. The importance of gaps for various ecosystem services and functions is well known, e.g. for preservation of biodiversity and complex old-growth structures. A large number of studies addressed effects of gaps on vegetation regeneration, animal abundance, soil characteristics, microclimate and other attributes. These studies struggled with the lack of an efficient, precise, and objective method to characterize the three-dimensional gap size. We present on overview of the history of gap surveys as well as recent developments and assess new technological possibilities that arise from the use of terrestrial laser scanning in forest canopy gaps. Fully automatic delineations of edge lines of forest gap can now be realized based on three-dimensional point

clouds obtained from laser scanning. Furthermore, gaps artificially created in deciduous as well as coniferous forests will be used to compare the results obtained from simulated conventional gap measurements (reproduced from the scan data) and sophisticated laser based measurements of gap area that take the complex shape of a gap edge line into account. This research will compare various methodologies and yield information about the accuracy of conventional measures of gaps of various sizes and shapes.

The relative effects of habitat amount, habitat configuration, and urbanization on forest breeding birds

**Alexandra V. Shoffner, University of North Carolina at Charlotte; Dr. Andrew M. Wilson, Gettysburg College; Dr. Sara A. Gagne, University of North Carolina at Charlotte*

It is clear that urbanization causes changes in landscape structure that adversely affect biodiversity. However, the relative impacts of different components of landscape structure remain unclear. Using the 2006 National Land Cover Database and 2010 U.S. Census data, we quantified forest amount, forest configuration, and urbanization intensity in landscapes spanning the state of Pennsylvania in order to distinguish the independent impacts of these three aspects of landscape structure on avian biodiversity in remnant forest. Abundances of individual forest bird species corrected for detection bias and forest bird species richness were estimated from a large and spatially-extensive dataset of point counts collected during the 2nd Pennsylvania Breeding Bird Atlas conducted from 2004 to 2008. Landscape structure variables were quantified in concentric 0.5-, 1-, 1.5-, 2-, and 5-km radius landscapes centered on point count locations within forest. Forest amount and forest configuration metrics were calculated using ArcGIS 10.2 and FRAGSTATS 4.2, and urbanization intensity was quantified using a principal components analysis of multiple land cover and Census-derived variables. We will present the results of analyses that test for the relative effects of the three landscape variables of interest on avian biodiversity. The outcome of our research will inform urban policy and planning to promote the conservation of avian biodiversity where people live and work.

The role of microenvironments, competition, and disturbance in mediating species' response to climate change across dynamic landscapes

Alexandra D. Syphard, Conservation Biology Institute; Josep M. Serra-Diaz, Arizona State University; Helen M. Regan, University of California Riverside; Janet Franklin, Arizona State University; Frank W. Davis, University of California Santa Barbara*

Predicting future effects of climate change on species' distributions and population dynamics is critical for conservation decision-making; yet, many interacting factors complicate our ability to make accurate projections. A major challenge is that species' response may vary across different life stages for long-lived organisms and may depend upon ecological processes and environmental controls that operate at different spatial and temporal scales. Species' response also likely depends upon interactions with other species and global change agents. To account for these complexities, we developed a multi-scale, multi-modeling framework that integrates measured tree species' tolerances to microenvironments from garden trials with fine-scale climate projections, species' demographic data, and projected change to disturbance regimes. We developed three modeling approaches to project tree species' response to future climate scenarios, each emphasizing different controls over species' persistence at different scales of ecological organization. We use RAMAS, a dynamic metapopulation model, to estimate detailed, species-specific demographic responses; BioMove, a demographic-landscape model that incorporates inter-specific competition and disturbance; and LANDIS-II, a forest landscape-succession model that simulates climatic effects on species' establishment and competition while more

mechanistically modeling disturbance dynamics. Results underscore the importance of accounting for high spatial and temporal resolution together with the interactions of disturbance and competition. Species' resilience will likely emerge as the interaction of vulnerabilities across life stages.

Forests and Biocultural Landscapes: The Case of Europe

*Mauro Agnoletti *, Antonio Santoro -Laboratory for Landscape and Cultural Heritage, GESAAF, University of Florence*

The cultural origin of the European rural territory has already been recognized by the European Commission in 1999. Forests are an integral part of this cultural heritage, because their density, structure, species composition has been deeply affected by humans in history, creating cultural forest landscapes in most of the European countries. The MCPFE (Ministerial Conference on the Protection of Forest in Europe) has developed the three pillars on which Sustainable Forest Management is based, including ecological values, economic values, as well as social and cultural values. However, no resolutions requiring to countries to develop strategies and actions for the preservation of cultural values have been developed. Some of the consequences are an idea of "naturalness" applied to places that are not natural threatening the conservation of cultural features. These problems occur also in the assessment of many UNESCO cultural landscapes. The results of these tendencies can be seen in the lack of conservation strategies for cultural forests and the continuous increase of the abandonment and renaturalization of the rural territory (800.000 ha /year in Europe). Measurements carried out in Tuscany in 14 study areas, shows a loss of about 45% in the cultural features of the forest landscape. This problem has been included in the national landscape monitoring system, developed by an expert group coordinated by the author. An important initiative for the development of new policies is the UNESCO-CBD Florence Declaration of 2014, recognizing the biocultural origin of the European Rural landscape.

Modeling system dynamics in rangelands of the Mongolian Plateau

Ginger R.H. Allington, School of Natural Resources and Environment, University of Michigan; Wei Li, Peking University; Daniel G. Brown, University of Michigan*

Arid rangelands are dynamic social-ecological systems that are influenced by a complex network of drivers, including climate, social institutions, market forces and broad scale policy directives regarding land tenure, use, and management. These factors are linked via feedbacks and often exhibit non-linear relationships. The sustainability and resilience of rangelands are dependent on the ability of residents and policy makers to respond and adapt to uncertainties in climate and the economy. However the complex nature of these systems make it difficult to predict the effects of changes to one aspect of a system and therefore what adaptations might be most advantageous. We're using a system dynamics model to understand how the human, natural, and land-use systems in the Mongolian plateau interact to produce dynamic outcomes in both grassland productivity and economic well-being of residents in Inner Mongolia and Mongolia. We synthesize disparate data generated in several previous studies to predict how ecosystem function and socioeconomic outcomes might change under alternative plausible climate, economic and land use futures. We demonstrate how feedbacks within and between the human and natural systems can lead to divergent outcomes, depending on the policy and adaptation measures that are adopted at local and regional levels.

Relative importance of landscape heterogeneity, crop identity and semi-natural field margins on functional diversity of rove beetles (Staphylinidae)

Aliette Baillod, Peter Batary, Yann Clough, Teja Tscharntke - Agroecology Georg-August University

Biodiversity in agricultural landscapes can benefit from enhanced landscape heterogeneity and the maintenance of semi-natural habitats. The effect of landscape heterogeneity is often studied as the composition of different habitats, whereas the configuration of habitats is usually disregarded. While the crop mosaic can provide different resources for arthropods, its configuration may have an impact on their movement. Crop mosaics are also interspersed with semi-natural boundaries such as grassy field margins, of which configuration may influence arthropods. We investigated how the landscape crop heterogeneity (composition and configuration), crop identity (wheat/oilseed rape), location within field (border/centre) as well as grassy field margins affect the functional diversity of rove beetles in central Germany. Rove beetles were sampled in simplified landscapes along uncorrelated gradients of crop diversity, field perimeter and proportion of grassy field margins. Rove beetle abundance and diversity responded to location within fields and crop identity. The beetle abundance was higher in field centers than in field borders. Predatory beetles were present in higher number in oilseed rape than in wheat fields. Finally, the diversity of rove beetles seemed to be determined basically by local scale effects, whereas landscape scale effects had a minor role in our simplified landscapes.

North American and European Landscape and Soundscape Ecology: A Perspective

Almo Farina, Department of Basic Sciences and Foundations, Urbino University, Italy*

Recently recognized as a distinct ecological discipline, soundscape ecology offers a great variety of innovative epistemological and methodological approaches useful to understanding the impacting effects caused by human intrusion on the Earth (e.g. climate forcing, biodiversity collapse, increase of social and economic inequality) and to assess the ecological debt in terrestrial and aquatic systems. Furthermore soundscape ecology seems an effective method to facilitate comparisons between different eco-regions where traditional investigations are not easily undertaken. The combination of different acoustic sources, including geophonies (e.g. wind, rain), biophonies (e.g. frogs, bird vocalization) and technophonies (e.g. cars, airplanes), create acoustic mosaics or sonotopes. In every sonotope the social interactions of acoustic communities create further typologies of biophonic patterns: the soundtopes. At the edge of the soundtopes, where different vocal communities are involuntarily in contact, the interaction of the acoustic signals creates the sonotones that are tension zones with properties similar to ecotones. The soundscape synthesizes acoustic processes and dynamics at population and community levels, and has therefore a finer texture than land mosaics, thus providing an excellent descriptor of landscape complexity. The soundscape also offers a portrait of the environment and allows unexpected comparisons with understandable results. This presentation discusses how the differences of landscape structures and scaling, land use and cultural background observed in North America and Europe could be more fully interpreted by linking the landscape with the soundscape.

Managing landscape fragmentation and connectivity to build multi-functional biodiverse landscapes

Matthew Mitchell, School of Geography, Planning and Environmental Management, The University of Queensland; Jonathan Rhodes, School of Geography, Planning and Environmental Management, The University of Queensland; Elena Bennett, Department of Natural Re*

The need to manage heterogeneous, human-dominated landscapes simultaneously for ecosystem services and biodiversity is increasingly important. Controlling landscape structure, especially fragmentation and connectivity, has the potential to be an important tool to meet this challenge. However, substantial gaps exist in our understanding of how landscape structure simultaneously impacts service provision and biodiversity. This presentation will begin by describing a new conceptual

framework that links landscape fragmentation with both the biophysical supply of ecosystem services and how those services flow to people. This framework predicts that fragmentation's effects on the flow of ecosystem services range from positive to negative and provides testable hypotheses about fragmentation's effects on final ecosystem service provision. Next, some of the dynamics that emerge from this framework will be described using a simple, spatially explicit model of habitat fragmentation and ecosystem service provision in a transformed agricultural landscape. Results from this model suggest that managing fragmentation could be key to creating equitable multi-functional landscapes. Finally, some empirical examples of the links between landscape structure, multiple ecosystem services, and biodiversity in both agricultural and urban landscapes will be discussed. In particular, how forest fragment isolation and agricultural field characteristics in southern Quebec drive the provision of multiple services, the diversity and abundance of key service-providing species groups, and tradeoffs among services. Together, the conceptual framework and empirical results demonstrate how managing landscape structure will be key to creating sustainable, multi-functional, and biodiverse landscapes.

Parallel Spatial Simulation of Urban Agglomeration in North Carolina, USA

Wenwu Tang, University of North Carolina, Charlotte, NC; Wenpeng Feng, University of North Carolina; Jing Deng, University of North Carolina; Meijuan Jia, University of North Carolina

Urbanization plays an important role in modifying and regulating landscape characteristics and functions. Spatial simulation, represented by cellular automata and agent-based models, has been increasingly used to study interactions between urbanization and landscape patterns in a decentralized manner. The spatial simulation approach is of great help for representing and understanding the space-time trajectory of urban development and associated complexity. However, spatial simulation of urban development has posted a considerable computational challenge for the study of urban agglomerations, which often cover a large spatial extent. Cyber-enabled parallel computing has been identified as an alternative to resolve this computational challenge. In this study, we present a parallel computing approach to support the spatial simulation of urban agglomerations in North Carolina, USA. We focus our discussion on the design of parallel spatial strategies that allow for efficiently harnessing high-performance computing capability for the large-scale modeling of polycentric urban development. We calibrate and validate the simulation model using empirical data in our study area. This parallel simulation approach offers us an ability to investigate the space-time complexity of urban agglomeration phenomena, which otherwise cannot be possible using desktop computing. More importantly, this parallel simulation approach provides substantial support for the study of the multi-scale impact of urban agglomerations on the sustainability of regional landscape.

Adaptive Urban Planning and Design

Jack Ahern University of Massachusetts Amherst, USA*

The ecosystem services concept is increasingly accepted to define sustainability and to assess and monitor progress towards specific sustainability goals. The delivery of a broad bundle of ecosystem services in urban environments challenges conventional and established planning and design knowledge - because the origin, scale, dynamism and uncertainty inherent to contemporary urbanism demand innovative strategies and solutions. In the social spirit of sustainability, development of these novel concepts should be conducted in a transdisciplinary process including stakeholders, decision makers, scientists and professionals. The need for new urban development and supporting infrastructure represent a unique opportunity to "learn-by-doing". While advances have been realized through pilot projects, they have limited transferability due to the inherent unique context and ecology of every urban environment. The promise of "learning-by-doing", therefore, remains a promising but elusive

goal. A transdisciplinary "learning-by-doing" model is proposed, including experimental design guidelines, monitoring and assessment protocols and strategies for realizing specific urban ecosystem services. The model is illustrated with precedent studies of international applications.

From land cover change modelling to landscape function change modelling: approaches to address landscape change beyond land cover change

David Eitelberg, VU University Amsterdam; Peter Verburg, VU University Amsterdam; Christine Ornetsmueller, VU University Amsterdam*

Land use models are often focused on land cover changes and driven by demands for food and urban space. However, many transitions in land use and land cover are driven by complex changes in society and lifestyles and the associated demand for a wide range of landscape functions or ecosystem services, including the conservation of biodiversity, regulation of climate and floods, and recreation.The traditional focus on land cover changes alone does not respect the importance of changes in land management and landscape configuration that affect biodiversity and the provisioning of ecosystem services. This presentation will present an alternative approach for land use modelling based on the simulation of changes in land systems in response to a wide set of ecosystem service demands. Simulations at global scale illustrate that accounting for demands for livestock products, carbon sequestration and biological conservation (following the Aichi targets) leads to different outcomes of land change models. An application in Laos indicates the complex transitions in land systems and landscapes that occur upon the transition from shifting cultivation to permanent agriculture and tree-crop plantations that cannot be captured by traditional land cover change models.

Ecological implications of energy use: a focus on scale

Virginia H. Dale, Oak Ridge National Laboratory; Esther S. Parish, Oak Ridge National Laboratory; Keith L. Kline, Oak Ridge National Laboratory; and Rebecca A. Efroymson, Oak Ridge National Laboratory*

Building on the seminal work of John Wiens, we focus on how scale of analysis and interpretation influences understanding of ecological implications of energy use. Understanding the environmental effects of alternative fuel production is critical to characterizing the sustainability of energy resources to inform policy and regulatory decisions. The magnitudes of these environmental effects vary according to the intensity and scale of fuel production along each step of the supply chain. We compare the spatial extent and temporal duration of ethanol and gasoline production processes and environmental effects based on a literature review and then synthesize the scale differences on space-time diagrams. Comprehensive assessment of any fuel-production system is a moving target, and our analysis shows that decisions regarding the selection of spatial and temporal boundaries of analysis have tremendous influences on the comparisons. Effects that strongly differentiate gasoline and ethanol-supply chains in terms of scale are associated with when and where energy resources are formed and how they are extracted. Although both gasoline and ethanol production may result in negative environmental effects, this study indicates that ethanol production traced through a supply chain may impact less area and result in more easily reversed effects of a shorter duration than gasoline production. Hence consideration of the scale of energy production and effects influences environmental policy and conservation opportunities related to energy.

Designing climate corridors for vulnerable plant species groups. Where climate corridors need to be constructed?

Hyeyeong Choe, UC Davis; James Thorne, UC Davis; Changwan Seo, National Institute of Ecology; Dongkun Lee, Seoul National University*

Vulnerability assessments are important tools for the establishment of climate change adaptation strategies. We identified plant species vulnerable to climate change by evaluating vulnerability components, sensitivity, exposure and adaptive capacity, based on their distributions, and suggested locations where climate corridors need to be constructed for South Korea. First, we modeled current and future distribution of 2,297 species. Since our data include large numbers of species with few records, we used the MARS (Multivariate Adaptive Regression Splines) multi-response SDM. We used Bioclim predictor variables for current and projected future climates to 2050 from HADGEM2-ES and NORESM1-M under four representative concentration pathways (RCPs). Based on the current spatial distributions of 2,297 species, we identified five groups by principal component analysis. We devised calculation methods for each vulnerability assessment component. We calculated the current climatically suitable areas for each species, and identified what will be unsuitable under future climate conditions for exposure. We defined sensitivity as habitat disruption, calculated by the difference of the suitable area proportions by species. We used the distance between central points of current and future habitats for each species as dispersal pressure. We defined species as vulnerable species groups when all vulnerability component values were above the average values for combined species. We discuss how to select the priority areas for climate corridors.

Soil degradation analysis as an important part of land degradation evaluation in the agrarian landscape

Borivoj Sarapatka, Marek Bednar - Palacky University Olomouc CZ

The rural landscape of the Czech Republic (CZ) has been changed, to a large extent, by intensive farming approaches, which have also influenced agricultural soils and their degradation. For the purpose of assessing the current state of soil degradation we have developed an overall indicator of land vulnerability to the threat of soil degradation on the basis of individual factors contributing to soil degradation, which are monitored on a long-term basis on various research worksites in CZ. On the basis of principal components of statistical analysis, individual degradation factors were assigned a specific weight of influence. With the use of a GIS instrument, the input factors of degradation were combined to create maps of individual types of chemical and physical soil degradation, and consequently a map of the overall degradation threat to soils within the CZ, along with a map of areas differentiated according to the prevailing type of degradation. Spatial statistical analysis was carried out to show possible relationship between total soil degradation and both natural and agricultural conditions. The results show that, at present, the most important degradation factor in the CZ is water erosion, followed by loss of organic matter. Statistical analysis shows that approximately 51% of agricultural land is moderately threatened.

Transitions in cultural landscapes in Europe: how policy choices affect biodiversity and land use

*Theo Van der Sluis, ALTERRA-WageningenUR *; Bas Arts, Wageningen University; Bas Pedroli, ALTERRA-WageningenUR*

In the past decades European landscape has seen a lot of changes. Strong economic, political and environmental drivers impacted most landscapes, and in particular the European market and regional policies have been very influential. The emblematic European cultural landscapes have changed less perhaps than everyday landscapes, due to the traditional land use practices which partly continue still, and the values attributed to the landscape identity, but also here changes are occurring, changes which are sometimes not visible yet. Well-known cultural landscapes like Cinque Terre in Italy, the Spanish Dehesa's or the moors of Dartmoor, all exist by virtue of traditional management, which evolved from

old farming systems. With the changing economic conditions, this traditional management is often transformed or discontinued. Cultural landscapes are generally characterized by a high cultural and biological diversity, and therefore a discontinuation of land use management often results in a decline in its biodiversity. We assess regions in Europe where important cultural landscapes are present, in which land cover is relatively stable, but which are in transition. For these regions we assess whether land use is predominantly characterized by change or by stability - and we classify the overriding factors. We use a number of case descriptions to analyse the dynamics of land cover and landscape change in cultural landscapes, and the driving forces for those changes. We focus in particular on landscape governance, and on how conservation policies do affect these landscapes. Finally, we assess whether governance strategies in Europe like the Council of Europe's European Landscape Convention and the European Union's policy intentions concerning Green Infrastructure, may hold promises for the future of cultural landscapes in Europe.

Over the river and through the woods: Comparing movement traits that influence dispersal ability amphibians across landscapes.

Evan M Bredeweg, Oregon State University; Tiffany Garcia, Oregon State University; Anita Morzillo, University of Connecticut*

Recent attention has focused on terrestrial movement and dispersal across landscapes as important parts of conservation of amphibian species. However, the application of dispersal movement to landscapes is difficult because of the multi-scalar interplay among physiology, behavior, and landscape features. At the scale of individual movements in anuran amphibians, jump distance is correlated with morphology, and possibly under strong selection as an anti-predator defense and flight behavior. However, it is unclear how jumping capacity impacts other movement behaviors at broader scales. To investigate how physiological performance, movement behavior, and landscape characteristics interact, we compared morphology, jumping performance, and short-term movement behavior in juveniles of three northwestern anuran species (Pseudacris regilla, Rana cascadae, and Anaxyrus boreas). This was achieved using photographic limb measurements, maximal jump distance, and fluorescent powder-tracking. Individual performance was tracked throughout the experiment and compared after accounting for differences in body size. We found that there were vastly different behaviors and abilities between the species tested. Past research suggesting that rear leg length is a determining factor in maximal jump distance was supported by our results for P. regilla but not R. cascadae and A. boreas. Body condition and maximal jump distance were found to be important factors for the free movement behavior of only P. regilla. Ongoing work includes experiments with individual movement decisions around diverse ground-layer substrates, and application of results to a spatially explicit population model to examine how these factors contribute to variability in movement behavior across landscapes.

Policy changes as a breakpoint in land use displacement in the Brazilian Amazon? Evidences for changes in deforestation, soy production and cattle ranching between 2001 and 2012

Florian Gollnow, Humboldt-Universitat zu Berlin; Tobia Lakes, Humboldt-Universitat zu Berlin;*

Land use models that analyze the impact of scenarios of land use change on ecosystems are limited by spatial scale. However, to capture spatial processes, such as land use, indirect land use change, and teleconnections, and at the same time map spatially explicit effects on ecosystems is difficult. The aim of this contribution is to combine a regional scale land use change model reflecting large scale processes with a spatially explicit landscape scale land use model. We propose a nested approach to reflect the multi-scale processes of land use change for the case study in the Brazilian Amazon. The study region is situated in Mato Grosso and Para State, one of the hotspots of deforestation during the last decades.

Land use changes are primarily linked to global demands for soybean, and cattle production and subjected to the implementation of several policies to control deforestation. We combine the LandShift land use model and the alucR land use model to develop scenarios of land use change from 2010 to 2050. The local scale land use change scenarios are embedded within the regionally trained land use model driven by global scenarios of production demands. This allows to map changes in land use under varying global to local scenario assumptions. Findings may hence reflect a more detailed picture of the multi-scale land use process.

Balancing supply and demand for ecosystem services provisioning of tropical forest patches in agricultural landscape

Yuri Arten Forte, University of SÃ£o Paulo; Silvio Frosini de Barros Ferraz, University of SÃ£o Paulo; Teresa Cristina Magro, University of SÃ£o Paulo*

Tropical forests worldwide are known targets of anthropogenic pressure and land use change. In Brazil, this environmental degradation process led the reduction of Atlantic Forest to small and isolated patches. Both deforestation and fragmentation disrupt many natural processes and, under a cascade effect, reduces the potential of ecosystem services provisioning by remaining forest patches. In this context, this study aims to analyze the role of tropical forest patches in ecosystem services provisioning under a supply and demand relation. The study was conduct in Corumbatai river basin, an agricultural landscape with great economic importance in SÃ£o Paulo State, Brazil. We established a one hectare grid for representing the 2011 forests in sample units (SU). For each SU it was calculated and analyzed services demand indicators (soil erodibility, slope, drainage density, proximity and visibility to road/urban areas) and supply ones (probability of connectivity, core areas, shape index, edge contrast and forest dynamics). Results of 68237 SU point out to a landscape formed by a mosaic of ecosystem services provision. In a single forest patch, regardless of size or spatial position, may occur SU that demand is greater than its supply potential. These areas are crucial to the increase in provision of forest ecosystem services. These data contribute to establishment of priorities for landscape conservation and restoration aiming to increase the effectiveness of these actions in agricultural landscapes.

Latitudinal variation in herbivory and defence in common evening primrose

Daniel N. Anstett, Department of Ecology and Evolutionary Biology, University of Toronto; Jeff R. Ahern, Laboratory of Organic Chemistry and Chemical Biology, Department of Chemistry, University of Turku, Finland; Juha-Pekka Salminen, Laboratory of Organ*

Understanding how species will interact across a changing climate is important to develop better conservation strategies. This requires an understanding of how species currently interact across climatic gradients. Plants and insects represent most macroscopic biodiversity on the planet and are thus a useful general model for studying the biogeography of species interactions. The prediction that herbivory and plant defences increase towards the equator has long been viewed as a well-supported pattern. However, recent studies call this hypothesis into question, which suggests alternative hypotheses might better explain biogeographic patterns of herbivory and plant defense in nature. We test this hypothesis by surveying 79 populations of Oenothera biennis (Common Evening Primrose) across a 16 degree North-South gradient from Ontario and Maine, to Alabama and Florida. Clines in chemical and physical defence traits were measured by growing and assessing 137 populations from the entire native range of evening primrose in a common garden. We show that latitudinal patterns in herbivory exist, but they vary dramatically among herbivore species. Specifically latitudinal patterns in fruit damage are higher at higher latitudes which is the opposite of the expected pattern. This unusual pattern is explained by more chemical defence in populations from lower latitudes, which is correlated

with lower levels of fruit damage. Overall, our results demonstrate that interactions between species over a landscape are more complex than originally envisioned. This suggests that more detailed monitoring may be required to establish how species depend on each other across a landscape.

Comparison and potential biases of landscape genetics and habitat modelling to estimate landscape resistance and movement corridors: an assessment for the brown bears in Spain

*Maria C. Mateo-Sanchez *, Technical University of Madrid; Niko Balkenhol, University of Gottingen; Sam Cushman, Forest Service. USDA; Trinidad Perez, University of Oviedo; Ana Dominguez, University of Oviedo & Santiago Saura, Technical University of Maine*

Enhancing connectivity in fragmented landscapes is a major focus of wildlife conservation efforts. Resistance models provide a key foundation for applied landscape connectivity analyses and are the most widely used data to model wildlife corridors. The prevailing resistance models to date are commonly based on expert opinion and, most recently, based on empirical data, commonly as a direct transformation of habitat suitability although the use of genetic data has drastically grown in the last decade. Landscape genetics research field can be particularly valuable towards this end because they provide a powerful means to infer how landscapes shape gene flow and thus how landscape factors affect species. However, the practical consequences of applying one or the other approach have not been broadly studied. To address this issue we performed a comparative study on the implications of using habitat suitability or genetic data to predict landscape resistance and population connectivity. We analyzed the case of brown bear in Spain because this is an endangered species for which connectivity has been identified as a major conservation concern, with potentially large implications for planning and conservation measures, and there exist an extensive amount of habitat and genetic data, which provides an unusually strong opportunity to address objectives stated above. The assessed approaches provided different connectivity models with notable differences in patterns of predicted connectivity predictions across the study area, particularly with regard to broad scale connectivity.

The "Blue" in Green Infrastructure in High-density Cities for Biophilic Urbanism

Kuei-Hsien Liao, Ph.D., Assistant Professor, School of Architecture, Chinese University of Hong Kong; Puay Yok Tan, Ph.D., Associate Professor, Department of Architecture, National University of Singapore

(updated) Explicitly linking natural elements with human wellbeing and sustainability, the concept of green infrastructure receives increasing attention in urban design and planning. While park systems and urban forests are also considered part of green infrastructure, much attention is on alternative stormwater runoff management features (e.g., rain gardens, bio-swales, and green roofs) that are more ecologically sensitive than the conventional urban drainage facilities. In such a form of green infrastructure that deals with water, it is largely the "green" element (i.e., the vegetation and the soil) that is focused as the infrastructure itself. The "blue" element often plays the role as the resulting benefit (e.g., the cleaner water). The blue element, such as urban streams and rivers, is relatively less explored in the concept of green infrastructure. The purpose of this presentation is to explore urban streams and rivers as green infrastructure itself, examining their ecosystem services and how they can function as green infrastructure. Through a comparative study on relevant policies on the use and management of urban streams and rivers in three Asian cities-Hong Kong, Singapore, and Taipei, this presentation discusses the role urban streams and rivers play in green infrastructure in high-density cities to move towards biophilic urbanism.

Global Importance of Pollinators and Other Beneficial Insects

Mace Vaughan, Pollinator Conservation Program Co-Director, Xerces Society and Joint Pollinator Conservation Specialist, USDA-NRCS West National Technology Support Center

This presentation will focus on global importance of pollinators and other beneficial insects for farmscaping and ecological service quantification. Crop pollination, is perhaps the best-known ecosystem service performed by insects and so the discussion will focus on the need to increase beneficial insect and native pollinators on farms. Beneficial insects, conservation biological pest management and native pollinators are critically important for cropping systems worldwide. Beneficial insects provide checks and balances for populations of crop pests throughout the world keeping pest outbreaks below an economically damaging level. Native pollinators help provide vital pollination services to a third of the food crops that we eat. This presentation will provide a detailed overview of the value and conservation needs of beneficial insects that support crop pest management and pollination. Discussion will also focus on the efforts currently underway across North America and Europe to increase delivery of these services on farm lands and the important role of enhanced and naturally occurring diverse habitat that supports on-farm populations of beneficial organisms. The Global importance of pollinators and other beneficial insects presentation will share tools for assessing habitat and the delivery of these ecosystem services at the local farm level. I will also demonstrate conservation practices adopted by farmers in different agroecosystems and discuss the critical need for GIS systems that support improved land management to increase the delivery of these ecosystem services.

Induced Land-use Change from rapid urbanization in the Pearl River Delta: Evidence, Impacts and Implications

Xia Li, Professor; Yimin Chen, Lecturer

Since the implementation of the opening policy and the economic reform, the Pearl River Delta (PRD) has become the leading economic region in China and even in the world. Over the past 30 years, the PRD experienced an unprecedented land-use change process to accommodate the growing economic activities and population. Now the PRD is one of the three largest urban agglomerations in China, but many social and environmental problems caused by rapid urbanization remain unsolved in this region. These problems are not unique and the PRD's experiences can be a reference for other developing regions in China. Thus, we would like to provide a review of the PRD's urban land-use change of the last 30 years and related problems. We first analyze the PRD's land-use change from the aspects of processes, rates, structures and spatial patterns. Then we discuss the impacts of the rapid land-use change to local environments and ecosystems, which includes resource demands, landscape alteration, and ecological consequences. Finally we summarize the responses made by the governments and agencies to better manage the urban land-use, and also introduce recent development progress of tools for land-use planning in the academic world.

Landscape management for ecosystem services and biodiversity: The role of landscape heterogeneity in landscape sustainability

Rebecca Chaplin-Kramer, Natural Capital Project, Stanford University

The agricultural expansion and intensification required to meet growing food and agri-based product demand presents important challenges to future levels and management of biodiversity and ecosystem services. The impacts of continuing land development are often not linear and can vary considerably with spatial configuration. We provide one of the first examinations of what could be gained by spatially explicit analysis of agricultural expansion at a large scale compared to the simple measure of total area

converted, with a focus on the impacts on biodiversity and carbon storage. Using simple modeling approaches for two regions of Brazil, we find that for the same amount of land conversion, the declines in biodiversity, carbon storage, and water purification can vary two- to four-fold depending on the spatial pattern. Impacts increase most rapidly in the earliest stages of agricultural expansion and are more pronounced in scenarios where conversion occurs in forest interiors compared to expansion into forests from their edges. This study reveals the importance of spatially explicit information in the assessment of land-use change impacts and for future land management and conservation.

Implementing biodiversity protection measures at the landscape scale: why non-instrumental arguments should not be neglected

Rob Bugter; BESAFE partners *Alterra, part of Wageningen University and Research*

For reaching its 'protecting and restoring biodiversity and associated ecosystem services' headline target for 2020, the new European Biodiversity strategy to 2020 still acknowledges the full implementation of the Natura 2000 network as critical. But the strategy now adopts the additional aim that 'by 2020, ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15 % of degraded ecosystems' and almost exclusively uses economic arguments related to Green Infrastructure outside N2000 to explain why and how biodiversity should be protected. As shown by the results of the European Union funded BESAFE project, focussing on the instrumental value of biodiversity can have particular added value at the local and regional landscape level by showing how biodiversity contributes to people's livelihoods. However, the project originated in concern that neglecting the role of the moral, non-instrumental values of biodiversity in justifying protection can be counter-productive, by undermining support for the protection of the parts of nature not delivering clear and direct economic benefits. That there is ground for this concern is shown by the results of BESAFE which indicate that biodiversity protection is still generally considered to be a moral issue. Non-instrumental values therefore still seem to be a strong pillar for conservation.
Although arguments about instrumental value can provide useful support in, for example, getting Green Infrastructure incorporated in landscape design and planning, care should be taken not to neglect the non-instrumental arguments. This is especially the case for the Natura 2000 network. Although it is the backbone of the Green Infrastructure, support for its implementation and maintenance probably mainly rests on its non-instrumental values. Neglecting those could therefore possibly jeopardise the whole strategy.

Shaping the future of cultural landscapes through participatory simulations. A case study in Senegal

Jeremy Bourgoin, Patrick d'Aquino - Centre de Cooperation Internationale en Recherche Agronomique pour le Developpement (CIRAD), Institut Senegalais de Recherche Agricole (ISRA); Alassane Bah, UCAD, Senegal*

Over the centuries, local communities have progressively tailored Sahelian cultural landscapes by developing complex and flexible overlapping institutions to continually adapt their rules and practices to the constant variability and scarcity of uncertain environments. Today, this institutional set up could provide the blueprints for dealing with uncertainty issues resulting from global change. The aim of our research is to design participatory modeling approaches that mobilize both, the structuring principles of institutional flexibility embedded in these communities and the relevant scientific knowledge accumulated in the last decades. In a modeling perspective, this implies a need for a modeling platform which is flexible enough for unusual ways of thinking about nature-society interactions. As a result, our aim has been to create a platform that is formatted to the least possible extent by the modeler's

worldview, while integrating landscape research knowledge. In this paper, we present a participatory modeling approach co-designed by practitioners and researchers that supports debate between the different societal ways of perceiving adaptation to uncertainty. The stakeholders involved in this participatory process were able to bring forward their adaptability principles and original perceptions of environmental management. These principles are derived from the rich pool of local knowledge on adaptation strategies to environmental changes and the complex collective rules that enable flexible but controlled access to natural resources. This paper also highlights that this multilevel simulation process is currently being transferred to Senegalese civil society to facilitate the insertion of local innovative knowledge into public land policies.

Integrating habitat heterogeneity into metapopulation approaches across scales

Robert L. Schooley, University of Illinois*

The notions of system openness and interactions between local and landscape processes effectively expressed in John Wiens' classic paper on 'Spatial Scaling in Ecology' are embodied in metapopulation approaches to species conservation in fragmented landscapes. Initially, species distribution models were developed that focused on effects of patch size and connectivity. Over time, habitat heterogeneity has been integrated into metapopulation models by considering habitat quality of focal patches and matrix effects on movement. Yet, there remains an inadequate recognition of how spatial autocorrelation of patch quality can create relevant heterogeneity and neighborhood effects at intermediate scales that link individual patches with the broader metapopulation. How we conceptualize and measure connectivity also depends on this autocorrelated habitat quality, which could be due to environmental gradients or land-use practices. I will use empirical studies focused on spatially-structured wetland species to explore these issues. I also will discuss general implications of autocorrelated habitat quality including information constraints and dispersal decisions by individuals. This habitat heterogeneity and potential for cross-scale interactions is not only important for metapopulation dynamics, but also for understanding constraints to ecological restoration, species responses to climate change, and disease spread in heterogeneous landscapes.

Integration of Cellular automata - Markov model and SWAT to predict land cover change and nutrient loads in Tra Khuc River Basin, Vietnam

Quan Vu Viet Du (1)(2), Huan Cao Nguyen (2), Veerle Van Eetvelde (1)
(1) Landscape research group, Department of Geography, Ghent University, Ghent, Belgium
(2) Department of Landscape ecology and Environment, Faculty of Geography, VNU University of Scien

In recent decades, the rapid socio-economic developments in Vietnam are main driving forces in land use/cover change (LUCC), especially in the coastal zone. Numerous LUCC models have been generated to propose the land use/cover scenarios and analyze its relationship to local environmental changes. The aim of this study is to predict land cover change and nutrient loads in Tra Khuc River Basin, to improve the understanding of their correlation.
The first task was to apply a stochastic modeling techniques by using Markov chain analysis (MCA) and Cellular Automata (CA) model. It was then used to simulate land cover change over a specific period. The steps were as follows: (1) Three land cover maps (1995, 2004 and 2012) were analyzed using MCA to present transition probability matrices, transition area matrices and conditional probability images; (2) Layers of spatial data were integrated by Multi-Criteria Evaluation (MCE) to obtain a series of suitability maps identified for each land cover class; (3) In the CA system, the output of steps above was combined to propose land cover scenarios in 2020 and 2029.

In the second task, fives land cover time layers and other data (soil, weather, DEM and hydrological network) were integrated to delineate subwatersheds and hydrologic response units (HRUs) in the basin area. The SWAT model was used to process all these data to model nutrient transformations (nitrogen, phosphorus) in subwatersheds over the different time layers. Finally, a regression analysis was conducted to assess the correlation between land cover change and nutrient loads.

Spatial pattern of Eurasian woolly mammoth extinctions during the Late Pleistocene based on statistical inference from fossil records

NULL

Late Pleistocene extinctions affected most large and low-fecundity mammals such as the woolly mammoth (Mammuthus primigenius) in Eurasia. Despite recent advances in both genetic and modelling approaches and increasing fossil data, assessing the relative importance of climate variations and human hunting on the spatial pattern of mammoth extinction remains a challenge. This is because estimating incomplete fossil time series biases the true dates of extinction and appearance, potentially leading to incorrect conclusion of the relative importance of individual and synergistic drivers. We compared outputs of two statistical models that (i) spatially infer mammoth final extinction dates and first human occurrence from sighting records based on the recently developed Gaussian-resampled inverse-weighted McInerny (GRIWM) and (ii) predict the date when mammoths should have gone extinct based on climate change only (climate anomaly and velocity). GRIWM generates a confidence interval of the true extinction time, which suggests a pattern of mammoths extinctions starting in central Europe and spreading toward both western Europe and north-eastern Siberia. Climate change had a minor impact on mammoth extinctions, mainly in the northeastern part of Eurasia where the synergistic hypothesis is mainly supported by our results whereas the human hunting hypothesis is more likely to have caused mammoth extinctions elsewhere in Eurasia.

Talking About Our Place - helping communities understand landscape benefits

Jonathan Porter, Jemma Brookes, Douglas Harman, Laura Partington, Paul Mahony, Countryscape; Elli Carlisle, Scottish Natural Heritage

The Talking About Our Place toolkit was developed to encourage communities across Scotland to get involved in shaping the future of their landscape. It responds to the requirements of the Aarhus Convention, Convention on Biological Diversity, European Landscape Convention and Water Framework Directive to engage all sectors of society in planning future landscapes. The Local Government in Scotland Act (2003) provides the legal basis for community planning in Scotland and places a duty on local authorities to initiate, maintain and facilitate community planning of public services. The purpose of the toolkit is to help communities: explore what makes their place special; recognise the benefits they derive from their local landscape; identify the issues which affect their place or may influence it in the future; and use this understanding to shape the decisions made about how their place should be managed. Resources include templates for project planning, fact sheets explaining different aspects of a landscape and a handbook of different methods for involving all members of a community. The toolkit adopts the ecosystem approach and contains information adapted from the UK National Ecosystem Assessment. The term 'landscape benefits' was used to help communicate the link between ecosystem services and human wellbeing. The workshop will explore the toolkit and discuss how it can be adapted for different contexts and communities. Lessons for supporting community engagement in landscape protection, management and planning will be discussed as well as mechanisms for sharing landscape tools across national boundaries.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Urban Dwellers at Risk in Poor Countries

Mark R. Montgomery, Economics, Stony Brook University, Stony Brook, New York; Poverty, Gender, and Youth Program, Population Council, New York

Most of the world's population growth will take place in the cities and towns of poor countries, where extreme weather events (floods, storm surges, landslides) cause harm to lives, livelihoods, homes, and other assets. In these countries, census data are rarely disaggregated to the local level. In the absence of such detailed data, multiple sources of information must be drawn upon to develop estimates of the numbers and characteristics of the at-risk population. This presentation provides summaries of urban populations at risk across the developing world, with particular attention to coastal areas.

The Alaotra Resilience Landscape, Madagascar

Patrick O. Waeber1,2, Lucienne Wilme3, Bruno Ramamonjisoa4, Claude Garcia1, 5. Affiliations: 1: ETH Zurich, Forest Management and Development, Switzerland; 2: Madagascar; Wildlife Conservation, Ambatondrazaka, Madagascar; 3: Missouri Botanical Gard

Tropical forest landscapes are shaped by the interlinked constraints of landuse and climate change. Increased demand for agricultural products, wood and fibers, the aspirations of rural and forest dwelling communities and a growing recognition of planetary boundaries outline the complex trade-offs resource users are facing day by day. How can we imagine landscape trajectories that will accommodate these apparently conflicting demands? We explore this question through participatory modelling, using the socio-ecological landscape of the Alaotra, Madagascar. In this region, local farmers derive their livelihood from the production of rice, vegetables, wood and charcoal. The area of production - rice fields, eucalyptus and acacia plantations - is expanding over the remaining wetlands and forests - as is the case all over the tropics. We have developed conceptual models that link actors, resources, norms and institutions, ecological processes and social dynamics through participatory modeling workshops with farmers, academics and decision makers. These are used to identify drivers of and barriers to change to explore alternative scenarios of landscape management. Recognizing and understanding the multiple linkages and feedback loops between all these components and processes is a necessary first step to design socially acceptable management strategies. This is especially important in times of rapid change such as new economic opportunities or political upheaval. But is knowledge sufficient? We propose that sustainability can only be achieved and resilience improved if the main resource users see their needs reflected in the framework used to make decisions - ownership of such conceptual models then becomes critical for landscape governance.

Part 1. From Management to policy: briding spatial scale. Discusion: How to achieve compatibility between different scales / how to avoid "leakage" effects

Moderatod by: Christine Furst; Discussant: Marion Potschin, University of Nottingham

NULL

Final Discussion & Summary

Benjamin Burkhard, Marion Kruse, Felix Muller; Kiel University*

NULL

Soils of Shrinking Cities: Properties and Potential for Multiple Ecosystem Services

Dustin L Herrmann, ORISE/US EPA, Cincinnati, OH; William D Shuster, NRMRL-US EPA; Ahjond S Garmestani, NRMRL-US EPA; Angela Knerl, ORISE/US EPA; Katelyn Gilkey, NRMRL-US EPA*

Sustained population decline in some cities has resulted in an extensive land use/land cover change from residential to vacant land use. This conversion is changing the spatial distribution of ecosystem function in the urban landscape. The conversion may improve the extent and provision of urban ecosystem services by beneficially leveraging plant-soil systems. However, the structure and function of soils in these landscapes are largely unknown. To address this deficiency, we collected soil cores to depths of up to 5 m in vacant lots in three U.S. cities (Cincinnati, Cleveland, and Detroit) that have experienced recent and long-term population declines and intensive, on-going residential demolition. Soil data were analyzed to identify and understand soil capacity to provide multiple ecosystem services, specifically detention of stormwater, support for plant growth, and carbon storage. We uncovered both native and disturbed horizons as well as fill materials. Both native and highly modified soils demonstrated high and low potential for ecosystem service provisioning. Ecosystem services were often bundled and spatially patchy, creating lower or higher ecosystem service provisioning in general within and among vacant parcels. Overall, we find the shifting urban mosaic in shrinking cities to a greater representation of vacant lot is not necessarily increasing ecosystem service provisioning. We hypothesize that a combination of land use history and current site activity push these ecosystems into low or high ecosystem service regimes that are reinforced by positive feedback loops. These high vs. low states affect city level outcomes. For example, patch-level feedback loops are controlling the potential for shrinking cities to manage stormwater runoff using a distributed, natural systems patch-based approach versus repairs and replacement of grey infrastructure.

Designing green infrastructure across heterogeneous mountain landscape - the Carpathians case study

Dusan Romportl, Faculty of Science, Charles University; Miroslav Kutal, Friend of the Earth; Vladimir Zyka, Faculty of Science, Charles University

The Carpathian Mountains forming an arc roughly 1.500 km across seven states provide the habitat for the largest European populations of brown bears, wolves and lynxes, with the highest concentration in Romania. However, Ukrainian, Romanian and even Slovakian parts of Carpathians suffer from the lack of functional nature protection and effective landscape management. Several protected areas including large number of NATURA 2000 sites have been declared, but their spatial design recalls rather patchwork instead of coherent network. Populations of large carnivores with enormous spatial requirements and extensive dispersal and migratory needs are widely endangered by rapid development of roads and motorways creating long impermeable barriers across the Carpathians. As new traffic projects are planned on supra-national level, the same scale is needed for designing extensive system of wildlife corridors. Habitat suitability models for large carnivores (brown bear, wolf, lynx) were used to delineate core habitat areas and stepping stones important for dispersal. The Circuit Theory was applied for assessment of landscape connectivity and finally coherent network of wildlife corridors was designed. Proposal of such green infrastructure was presented to regional authorities and stakeholders, to provide them with relevant information for negotiation with road and motorways planners.

Scenario-based assessment of the effect of urban landscape configuration on ecosystem regulation of water quality

Douglas A. Shoemaker, North Carolina State University; Brian R. Pickard, North Carolina State University; Ross K. Meentemeyer, North Carolina State University*

Expanding societal demand for multifunctional landscapes is broadly restructuring the urban-rural frontier, converting greenfields to accommodate increased human activity and shifting the burden of ecosystem provisioning to remnant natural capital. The resilience of these shifting frontier ecosystems is largely unknown, and scale mismatches between jurisdictionally-constrained environmental regulation and ecosystems have created vulnerability to the impacts of cross-boundary and aggregated growth. Regional planners have responded by encouraging development which minimizes environmental impacts (e. g. "green growth"). However, the ability of these proposed land system architectures to preserve ecosystem function remains largely untested, and tradeoffs exposed by the implementation of such designs are unknown. In this study we modeled the effect of urban configuration on ecosystem service regulation using a reduced-complexity case designed to expose spatial interactions between land cover mosaics and landscape retention of non-point source pollution (NPSP). Coupling patch-based land change and ecohydrological models allowed us to assess landscape response to five scenarios of laissez-faire and prescribed urban growth by estimating balances of nitrogen (N) and phosphorus (P) loading, retention and export across 37 urbanizing watersheds. Preliminary results found land cover configuration more influential in NPSP exports than magnitude of change. Comparison of alternative architectures found NPSP exports reduced when development pattern restricted connectivity along hydrological gradients. However, no single architecture optimally reduced both N and P, a finding that emphasizes the need to understand tradeoffs. These early analyses suggest that place matters, and regional implementation of select architectures can reduce the impacts of aggregated growth on ecosystem function.

Historical fire effects on forest structure and composition in the southern Blue Mountains, OR, USA

James Johnston; John Bailey. Oregon State University*

Treatments to restore resiliency to fire-adapted conifer forests of western North America are typically designed to synchronize structural and compositional patterns to historical wildfire processes. Most researchers emphasize the importance of frequent low-severity fire in maintaining relatively open pine-dominated forests and invoke "mixed-severity" fire regimes to account for the more complex structure and composition observed on more productive mixed conifer sites. Other studies implicate stand-replacing fire as a major driver of forest structure and composition across a wide range of forest types. This study reconstructs multi-century fire occurrence and tree establishment at ten sites that span a wide range of forest types on the 688,000 ha Malheur National Forest in eastern Oregon. Although standard succession and disturbance models assume that frequent fire excluded fire intolerant late seral species, we found relatively frequent (<18 year MFRI) fire in forests that were historically dominated by fire intolerant species. Current theory suggests that frequent fire in dry pine sites created compositionally and structurally stable uneven aged stands, while higher fuel loading in more productive moist mixed conifer stands resulted in coherent regeneration pulses following periodic mortality events. However, we found evidence of significant disequilibrium in forest structure on dry pine sites, while most moist mixed conifer sites appeared compositionally and structurally stable over time. These results suggest the need to develop new conceptual frameworks that better link data about historical fire occurrence to landscape context, edaphic and climate controls, and interactions with drought and insect disturbances.

Spatially-explicit Tools and Metrics for Soundscape Mapping

Kathleen J. Vigness-Raposa, Jennifer L. Giard, William T. Ellison - Marine Acoustics, Inc.; Brandon L. Southall, Southall Environmental Associates, Inc.*

Soundscapes, or acoustic scenes, emphasize the way in which the acoustic environment is perceived by an individual, species, or society. Traditional maps of soundscapes have focused on integrated sound levels of all sources, whereas potential impacts are usually assessed on the basis of exposure to one sound source. Recent studies have demonstrated that perception is dependent not only on sound level, but the context under which sound exposure occurs, including the type of sound source, the state of the individual, and the quality of the environment. We propose spatially-explicit tools and metrics that merge the broad soundscape with the narrow single source/single species impact approach to include: relative levels of sound exposure, such as loudness, signal to noise ratio, and sensation level; metrics for evaluating chronic elevation in background noise; cumulative exposure to an individual from multiple and dissimilar sound sources; as well as the potential for animals to selectively avoid a particular source and other behavioral changes. Incorporating these concepts into an overall acoustic scene analysis requires a more holistic and multi-dimensional approach that addresses the spatial relationships among noise environment, animal hearing and behavior, and anthropogenic sound sources. We present a layered mapping approach that considers each facet of the soundscape in a spatially-explicit manner. Our exemplar is the underwater environment of the Gulf of Mexico with layers for ambient noise, shipping, and distant anthropogenic sources, where exposure to a nearby seismic survey is filtered by the animal's hearing sensitivity, sensation level, and nominal loudness of the signal.

Citizen Science Helps Predict Risk of Emerging Infectious Disease

Ross K. Meentemeyer, North Carolina State University; Monica A. Dorning, United States Geological Survey; John B. Vogler, North Carolina State University; Douglas Schmidt, University of California - Berkeley; Matteo Garbelotto, University of California -*

Engaging citizen scientists has become an increasingly popular technique for collecting extensive ecological data while also creating an avenue for outreach and public support for research. Here we demonstrate a unique opportunity where citizen scientists have played a key role in the spatial prediction of an emerging infectious disease across heterogeneous landscapes. The yearly citizen science program called "SOD (sudden oak death) Blitz" engages and educates volunteers in detecting the causal pathogen during peak windows of seasonal disease expression. We used these data - many of which were collected from under-sampled urban ecosystems - to develop predictive maps of disease risk and inform where stakeholders should prioritize prevention efforts. We found that continuing the SOD Blitz program over six consecutive years improved our understanding of disease dynamics and the accuracy of our predictive models. We also found that self-identified non-professionals were just as capable of detecting disease as professionals. Our results indicate substantial promise for using long-term citizen science to predict the risk of emerging infectious plant diseases in urban ecosystems.

Local- and Landscape-Level Drivers of Avian Community Assemblages in Subtropical Forested and Agricultural Habitats

Kathryn Battle, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, North Carolina State University; Krishna Pacifici, Department of Applied Ecology, North Carolina State University; Jaime A. Collazo, U.S. Geological

There is a recent impetus in ecology to disentangle the influence of spatial scales on biological processes to achieve holistic conservation in both protected and human-altered environments. Occupancy modeling offers a statistically robust method to predict where species occur after accounting for imperfect detection, and also to explore the relative influence of factors influencing occupancy at different spatial scales. Using a standard point count protocol, we sampled the entire avian community three times each at 120 sites representing either forest, sun-, or shade-grown coffee habitats

throughout the western, mountainous region of Puerto Rico. At each site, we also collected data summarizing configurational and compositional spatial features characterizing both local- and landscape-levels to detect which features at which scales best explain why certain community assemblages are present in some habitats yet absent from others. At the local level, we investigate the importance of vegetation composition, structure, and the use of certain agrarian practices towards explaining the predominance of certain avian guilds occupying forests and coffee plantations. At the landscape-level, we utilize remotely sensed data about landuse/landcover to calculate domination and contagion metrics to determine the influence of external drivers on bird community composition within a focal patch. We then fit spatially-explicit hierarchical community occupancy models to the data. These models will reveal not only the probability of species' occupancy across habitats of interest (forests, sun- and shade-grown coffee plantations) but also the relative significance of those spatial drivers proposed on species' occupancy. Our data will inform decision-makers in the Department of Natural Resource and Environment, the Natural Resource Conservation Service, and U.S. Fish and Wildlife Service as they prioritize habitat conservation efforts in order to maximize biodiversity and promote the persistence of endemic avifauna.

Woody encroachment in mountain landscapes: Impact of climate change and management on tree expansion rates

Rebecca Snell, Forest Ecology, ETH Zurich, Switzerland; Alexander Peringer Laboratory of ecological systems, Ecole polytechnique federale de Lausanne (EPFL), Switzerland; Harald Bugmann, Forest Ecology, ETH Zurich, Switzerland*

Woody encroachment in mountain grassland ecosystems is increasing in many regions, likely due to the combined influences of changing management practices, land abandonment and climate change. However, predicting how these landscapes will continue to change in the future remains a challenge due to the disparate scales in time and space that govern the dynamics of these systems. To improve our understanding of the processes and interactions that shape these ecosystems, we modified a dynamic forest landscape model to simulate alpine meadows and pasture-woodland landscapes in Swiss mountains. This involved the inclusion of an herbaceous layer, grazing from cattle, and additional management routines. We used this model to simulate the combined influences of future climate change, pasture and forest management on the rates of woody encroachment for two Swiss landscapes; (1) an alpine meadow above the tree-line and, (2) a low elevation pasture-woodland. While climate change did increase the rate of woody encroachment, management practices had a much larger and more immediate influence. The results of this study could help identify strategies to slow down or reverse woody encroachment in mountain landscapes.

Closing Discussion

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Predicting forest aboveground biomass in diverse landscapes: A global sensitivity analysis of the LANDIS-II model

Erin Simons-Legaard, University of Maine School of Forest Resources; Kasey Legaard, University of Maine School of Forest Resources; Aaron Weiskittel, University of Maine School of Forest Resources*

Forest landscape models have become a valuable tool for projecting broad-scale forest dynamics, but incomplete knowledge about model behavior can make parameterization challenging and outcomes

unreliable. Our aim was to evaluate parameter sensitivity with respect to predicting live aboveground biomass (AGB) with the widely-used LANDIS-II. Designed to be flexible and process-based, LANDIS-II only requires a moderate number of parameters. Representations of ecological processes are still relatively complex, however, and because some parameters were designed to be more or less influential depending on successional stage, a sensitivity analysis that is not global nor explicitly considers time-dependence could be misleading. We performed a global sensitivity analysis on nine parameters required by LANDIS-II or its Biomass Succession Module. To fully explore interactions, nonlinear behavior, and boundary conditions, we selected a range of values that was much wider than in previous studies, but still representative of LANDIS-II applications in North America. Our results showed commonalities with local sensitivity analyses, which concluded the maximum allowable biomass and maximum annual net primary productivity specified for a species were most influential when predicting AGB. In contrast to earlier work, we also clearly demonstrated how relative importance was time-dependent for all but the least important parameters. Interactions between parameters and simulation duration generated substantial variability in AGB and number of cohorts established. Results can help improve model calibration and offer insight into opportunities for possible model refinements, but also suggest that parameters which cannot be calibrated empirically may be a major source of continued model uncertainty.

Quesiton & Answer and Closing Discussion

Sadahisa Kato, Ibaraki University

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Applying diffusion models to host, parasitoid, and predator movement in natural landscapes

John D. Reeve, Southern Illinois University Carbondale*

Diffusion models provide a flexible framework for quantifying the dispersal and movement of insects. They can be used to address several key ecological questions, including the spatial extent of populations, how dispersal is affected by edges or boundaries between landscape elements, and the relative dispersal abilities of natural enemies and host species. I present applications of diffusion models to dispersal processes in two systems, a prairie planthopper and its minute egg parasitoid, and bark beetles and their predators in pine forests. Mark-recapture experiments were conducted to estimate diffusion model parameters, yielding estimates of the diffusion rate for different habitats plus those governing edge behavior. The results indicate that dispersal rates can vary greatly between habitat types, that strong edge behavior occurs in both systems, and that host and natural enemy behavior differs in the same system. The models are also used to examine the impact of an invasive weed on planthopper persistence, and how dispersal from a bark beetle-infested forest may contribute to outbreaks in adjoining areas. A new technique for estimating the parameters in these models is also be introduced.

Approaches for (re-)coupling socio-cultural and ecological landscape domains: Examples from Europe

Claudia Bieling, University of Freiburg / University of Hohenheim; Maria Garcia Martin, University of Freiburg*

Cultural landscapes are valued as everyday living environment, heritage, scenery with aesthetic and recreational qualities and unique biodiversity. However, they are undergoing fundamental transformations. Although the specific drivers and outcomes of these processes vary greatly, a central tendency is the decoupling of the socio-cultural and ecological sub-systems. This leads to the degradation of values and renders the future of many of these landscapes highly uncertain. Based on

recent reviews, this paper presents a Pan-European overview on two types of approaches that foster strong linkages between socio-cultural and ecological landscape domains and, at a very practical level, integrate the cultural dimension and landscape ecology. The one type addresses the multiplicity of values inherent in landscapes, which is at the center of Integrated Landscape Initiatives. These are defined as multi-stakeholder activities to foster the provision of a broad range of landscape values (including biodiversity) through integrated planning, decision-making, and management. The other type of activities has a particular focus on the temporal dimension of landscapes. Taking up the notion of interconnected cultural diversity and biodiversity, heritage is understood as a crucial link between people and place. In this line, a multitude of local initiatives are directed towards strengthening the creation of meaning, value and knowledge in regard to landscape histories (and futures), typically considering mutually reinforcing relationships between heritage and other landscape values. Based on the review of these two types of approaches, the paper will discuss possibilities and challenges for strengthening linkages between socio-cultural and ecological landscape domains.

Does proximity and size of native pollinator nests predict orchard tree yield?

Insu Koh, University of Vermont; Eric V. Lonsdorf, Frank & Marshall College; Derek R. Artz, Pollinating Insects Research Unit USDA-ARS; Theresa L. Pitts-Signer, Pollinating Insects Research Unit USDA-ARS; Taylor H. Ricketts, University of Vermont.

The use of managed honey bees to enhance crop pollination has become increasingly uncertain due growing losses of managed hives. In response to these losses, growers of almonds, apples, and other orchard crops have begun to explore alternatives to honey bees by enhancing nesting habitats for native bees by placing nest boxes within the orchards. The spatial influence of these nest enhancements on crop yields has been poorly studied. Here, we analyze yield data from almond orchards in California. We predict that almond yields increase with decreasing distance of nests and increasing size of nests. We located different size of nest boxes of native blue orchard bees across the 61 ha orchard area and measured nut weight of a total of 216 almond trees in 2012. Then we developed a spatially-explicit model to predict the density of bees foraging from the nests to each almond trees, using a range of distance decay parameters (i.e., average foraging distances for bees). We compared the relationship between the predicted bee density with measures of nut yields for individual almond trees. We found that nut yields significantly increase with our measure of bee density and that the best estimate of foraging distance was roughly 200 m. This result and approach can be applied to find optimal solution of the spatial allocation of insect pollinator nest habitats in orchards.

Mapping Land Cover and Land Cover Change at Mt. Kasigau in Southeastern Kenya Using Multi-season Landsat Data

John K. Maingi, Miami University; Kimberly E. Medley, Miami University; Daniel Pearlman, Miami University*

Mt. Kasigau forms the northeastern limit of the Eastern Arc Mountains that have been described as discrete islands with localized areas of high rainfall surrounded by a comparatively arid woodland. The mountains are noted for their high species richness, high concentration of endemic species, and highly fragmented condition. Multi-season Landsat images and ancillary data were used together with training data obtained through fieldwork and from a high resolution WorldView-2 image to produce land cover maps for three time periods: 1975-1979, 1995-2001, and 2010-2014. The eight vegetation classes targeted for mapping had been identified through classification and ordination of vegetation data obtained from 55 sample plots. Landscape metrics were calculated for each land cover map and compared to quantify landscape change. In addition, post-classification comparisons were used to

identify broad changes that had occurred between 1975 and 2014. The most prominent changes identified occurred in the low-lying plain surrounding Mt. Kasigau in which agricultural area expanded and bushland vegetation became more fragmented. There was also increased patchiness in the montane woodland classes occurring at lower elevations of the mountain. Spectral mixture analysis was used to identify subtle changes that had occurred over the montane woodland and forest classes in both the dry season (1995-2011), and in the wet season (2001-2014).

Assessing the Effects of Climate Variability on Lateral Hydrological Connectivity of Taxodium-Nyssa Ecosystems

John Kupfer, University of South Carolina; Kimberly Meitzen, Texas State University; Peng Gao, University of South Carolina; Aashka Patel, University of South Carolina; Daniel Tufford, University of South Carolina.*

The strength and nature of permanent and episodic links between the mainstem of a river and the ecosystems of its alluvial floodplain are central to dictating processes that shape floodplain ecology and habitat diversity. Understanding the ways that human-induced changes in climate and hydrology alter those linkages is, in turn, necessary for the successful implementation of flow regimes that meet human needs for water in a manner that sustains the ecological integrity of affected systems. In this study, we coupled results from a watershed simulation model (winHSPF) with a 2-D flood inundation model (TUFLOW) to simulate hydrologic responses to four mid-21st century climate change scenarios in the watersheds upstream of Congaree National Park. Flood regimes were mapped by translating measures of river discharge into high resolution maps of flood conditions, and the connectivity of Taxodium-Nyssa forested swamps to the mainstem river and to each other were analyzed utilizing a graph network approach. Projected average seasonal riverflows for summer months were consistently higher under future climate scenarios, which would result in greater connectivity of Taxodium-Nyssa swamps but potentially prolonged flooding at a time when the floodplain is usually driest. In contrast, average seasonal riverflows for winter and spring months, when floodplain connectivity is typically most important because it facilitates seed dispersal and habitat access for floodplain spawning fish, decreased by as much as 15-20% under some models. Our results provide critical information to facilitate the management of flood processes that maintain floodplain connectivity in the face of changing climatic conditions.

Best Practices for Mapping Ecosystem Services: the quest for "a green bullet"

Louise Willemen, Faculty of Geo-Information Science and Earth Observation (ITC) University of Twente; Benjamin Burkhard, Institute for Natural Resource Conservation Kiel University & Leibniz Centre for Agricultural Landscape Research ZALF; Neville Crossm*

Plurality in ecosystem service definitions and applications has resulted in a wide variety of methods to quantify and map ecosystem services (ES). This diversity challenges the mainstreaming of ES information into policy making, natural resource management and green accounting. The Mapping and Modelling working groups of the Ecosystem Service Partnership (ESP) took up the challenge to provide structure and guidance on ES practices. In this scope we developed a documentation scheme for ES maps, a checklist of information and decisions needed for ES mapping, and an online data sharing platform for ES maps (esp-mapping.net). In our exploration for best ES mapping practices -our quest for "a green bullet"- we synthesized the applicability of ES mapping methods under specific geographic characteristics and user objectives. The synthesis was based on a collection of papers in Special Issue Ecosystem Services on this theme. Best ES mapping practices are robust, transparent and stakeholder-relevant. These therefore include robust modeling and measurement methods of ES supply, demand

and/or flow, as well as measures of uncertainty and heterogeneity at the appropriate scale and resolution. Best practices are transparent to contribute to information-sharing and the creation of linkages with decision support tools. Lastly, best ES mapping practices are people-central in which stakeholders are engaged at different stages of the mapping process. We found a paradox in our quest for a green bullet; standardized measures and mapping methods increase information-sharing and decision-making impact, whereas a plurality of approaches is needed to address different user needs, objectives and data availability.

Using LCD to Promote a Collaborative Approach to Resource Decision-making

John A. Rice, Southern Rockies Landscape Conservation Cooperative

The Southern Rockies LCC (SRLCC) began funding science in 2011. Since that time, the SRLCC has adopted a strategic conservation framework, focal resources and geographic focal areas. This has allowed us to strategically acquire and develop science related to partner identified needs. In 2014, the SRLCC initiated the Green River Basin Landscape Conservation Design (LCD) project. The project will provide significant opportunities to develop partnerships, and will promote a collaborative and organized approach to resource decision-making along a several hundred mile stretch of the Green River in Wyoming, Colorado and Utah. The landscape design will play an important role in a science acquisition and development strategy that promotes a link to on-the-ground management decisions.

Land-use diversity supports access to nutritionally-important foods in a semi-arid, mixed forest and farm landscape in Burkina Faso

Bronwen Powell, CIFOR, , Morocco; Amy Ickowitz, CIFOR, Bogor, Indonesia; Michael Balinga, CIFOR, Ouagadougou, Burkina Faso; Mathurin Zida,CIFOR, Ouagadougou, Burkina Faso; Terry Sunderland, CIFOR, Bogor, Indonesia*

Understanding how different aspects of the landscape contribute to diet quality is key to landscape management approaches that support global efforts to reduce malnutrition. We worked in 10 communities in south-west Burkina Faso, in a landscape of tree-scattered fields and a significant amount of dry forest. We used mixed methods to examine how Dagara people think about and categorize land use within their landscape and the ability of different land-use types to provide nutritionally-important foods. Dagara people classify their landscape into 3 predominant categories of land use: cultivated, uncultivated and sacred land. Within these categories land-use types are further classified according to: amount of water, tree cover, and distance from the home. Fields are the most important for grain. For meat, bush and forest rank more highly than land specifically designated for domestic animal grazing, because they supply wild meat. Fish are obtained from streams and rivers. In areas close to the home trees with edible leaves are found, and, in the rainy season, weedy herbs are collected. In the dry season gardens are an important source of vegetables. More distant trees in both cultivated and uncultivated land are a source of leaves dried for use in the dry season. Because vegetables are procured in multiple ways, having access to diverse land-use types supports vegetable consumption. Fruit, like vegetables come from trees scattered across different land-use types. Across all 5 food groups uncultivated and cultivated land were equally important.

Relationships between habitat loss and habitat fragmentation during urbanization: A long-term analysis for 16 world cities

Zhifeng Liu, Beijing Normal University; Jianguo Wu, Arizona State University; Chunyang He, Beijing Normal Univeristy*

Urbanization results in habitat loss and habitat fragmentation, both of which influence biodiversity and ecological processes. To evaluate these impacts, it is essential to understand the relationships between habitat loss and habitat fragmentation per se during urbanization. This study addresses two key questions that are yet to be fully understood: (1) Do habitat loss and habitat fragmentation per se show any consistent relationship as urbanization unfolds? (2) How does the relationship between habitat loss and habitat fragmentation per se during urbanization compare with that during deforestation reported in the literature? To address these questions, we used the landscape metrics and the regression analysis to examine the relationship between habitat loss and habitat fragmentation per se in 16 large cities around the world from 1800 to 2000. Our results show that habitat loss and habitat fragmentation are significantly correlated during urbanization for all the 16 cities. A monotonic relationship - linear, exponential, and logarithmic - was found between the habitat proportion and fragmentation, indicating that with the loss of habitat, the degree of habitat fragmentation per se increases. In addition, most forms of the relationship were consistent with those of deforestation, except for cases where fragmentation was measured by edge density, landscape shape index, and nearest neighbor distance. Our results show both generalities and idiosyncrasies in the relationship between habitat loss and habitat fragmentation per se during urbanization, with implications for assessing ecological effects of urbanization.

Establishment patterns of yellow-cedar (Callitropsis nootkatensis) at a current range edge: a climate-threatened tree's migration north and east, and implications for conservation planning

John Krapek, University of Alaska Fairbanks; Brian Buma, University of Alaska Southeast; David Verbyla, University of Alaska Fairbanks; David D'Amore, US Forest Service; Paul Hennon, US Forest Service*

Yellow-cedar (Callitropsis nootkatensis) is a culturally and economically important tree species experiencing a substantial decline in portions of southeastern Alaska and British Columbia, which has been attributed to the rapid climate changes of the past century. At the same time, yellow-cedar is undergoing a continued natural range expansion (north and east) in southeast Alaska since the Last Glacial Maximum. Our research is addressing fundamental yellow-cedar population ecology questions at a current northeast range edge near Juneau, Alaska where yellow-cedar populations appear to have recently established in the past ca. 1,000 years. Examining establishment patterns at a current range edge, we hope to understand what landscape factors (abiotic and biotic) facilitate the establishment of new yellow-cedar populations ahead of its range. This information could then be integrated with conservation and management approaches to better understand where yellow-cedar populations will establish on the landscape under future climate scenarios. We are using a detailed stem-mapping procedure and spatial analysis methods at our study populations to address these questions."

What drives avian species diversity? A species-centered approach to testing the 'environmental filtering' versus 'landscape species pool' hypotheses

Katherine E. Halstead, Klamath Bird Observatory; John D. Alexander, Klamath Bird Observatory; Jaime L. Stephens, Klamath Bird Observatory; Matthew G. Betts, Oregon State University*

Understanding the drivers of species diversity is central to ecology, and is critical in conservation planning. Species richness has been traditionally predicted as a function of local-scale habitat structure and composition (i.e., environmental filtering), but in recent decades the importance of broader spatial scales (i.e., the landscape species pool) has been acknowledged. Dispersal limitation, influenced by the spatial pattern and extent of species' habitats in the landscape, is the primary mechanism expected to drive such landscape-level effects. However, as 'habitat' is well known to be a species-specific concept, estimating the abundance of potential dispersers at large scales and across species is a major challenge.

We employed a novel species-centered approach for estimating habitat amount across 48 common bird species in southwest Oregon, using boosted regression trees with unclassified Landsat TM to create 'stacked' species distribution models (S-SDMs). We tested the relative importance of S-SDM-based estimates of local-scale and landscape-scale habitat amount in explaining local richness for the pool of 48 species and a subset of highly oak-associated species. Our results provide evidence for the influence of both local and landscape processes on local bird diversity. Additionally, the relative importance of habitat at the two scales was dependent on the species subset considered, suggesting a greater influence of dispersal effects for the inclusive species pool but environmental filtering for oak specialists. We conclude that the S-SDM approach offers promise for testing ecological theory on species distributions, and for prioritizing areas diverse in both at-risk and common species for conservation.

Discussion

Jacques Baudry & Yunhui Liu

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When a bird goes "unheard": pervasive road noise disrupts critical heterospecific alarm call functionality

Aaron M Grade, School for Natural Resources and Environment, University of Florida*

Anthropogenic road noise, especially from heavy-use interstate highways, can disrupt acoustic communication systems in a number of organisms. In North-Central Florida state parks, I conducted a comparative playback study to investigate the impact of highway noise on Eastern Tufted Titmouse (Baeolophis bicolor) alarm call detection and behavioral response in Northern Cardinals (Cardinalis cardinalis); a heterospecific information "eavesdropper" that relies on Titmouse alarm calls to mitigate predation risk. Behavioral response by Cardinals to the alarm signal dropped drastically and significantly at relatively low levels of constant background noise from the road source (â‰¥ 48 dBA). Using a combination of GIS-based modeling and empirical measurements of the soundscape of the state parks, I determined that the highway noise permeates far into areas of the park that are otherwise buffered from edge and anthropogenic effects. Scaling these findings up to the entire range of these two species in the intercontinental United States highlights the potential degree of impact that human noise imposes on this communication system. Empirical studies such as this can inform natural soundscape conservation proponents in making management and infrastructure planning decisions.

Simulate the eastern boreal-temperate forest transition using a state-transition approach

*Steve Vissault*Â¹, Isabelle BoulangeatÂ¹, Matt TallutoÂ¹ et Dominique GravelÂ¹ Â¹ Departement de Biologie, chimie et geographie, Univiversite du Quebec Ã Rimouski*

The location of the eastern temperate-boreal forest ecotone is expected to be affected by climate change in the next decades. Several tree species representative of the temperate forest are predicted to move northward (e.g. red and sugar maples) and through the boreal forest. These major biomes host a very contrasted biodiversity and are subject to different ecosystem functioning. Here we ask how fast the location of the ecotone will move under climate change. To explore this question, we develop a transition landscape model based on four forest states: boreal, temperate, mixed and post-disturbance regeneration. The model uses climate-dependent transition probabilities between forest types and incorporates dispersal. We parameterize the model on an extensive database of > 200 000 permanent forest inventory plots widely distributed along a latitudinal gradient in Eastern North America, from Florida to north Canada. We find that the observed transitions between the different states successfully

predict the location of the ecotone. The model predicts a northward shift of the ecotone. We also find that the migration will occur very slowly and consequently will generate a significant lag between the potential distribution of the temperate forest and his observed distribution. Our results also emphasize the role of disturbances such as fire or logging on this spatial lag, and highlight the limits of the climate as only predictor of the future á¸'istribution of forests at the ecotone. Our modelling approach solve several issues of the more traditional species distribution models with explicit consideration of biotic interactions, demography and dispersal.

The Seascape Genomics of Coastal Pollution

Jonathan Puritz, Harte Research Institute, Texas A&M Corpus Christi*

Human beings have impacted every ecosystem on the planet, and these anthropogenic changes have lead to an unprecedented loss of biodiversity. There is a critical need for biologists to investigate the natural processes that maintain biodiversity, AND to understand the ways that human beings are impacting these processes. Coastal ecosystems, in particular, face a complex of stressors from human activities on land and the ocean, and understanding how these human stressors interact with marine populations is fundamental to effective conservation. Marine species also present a unique challenge for molecular ecologists: a variety of life history strategies from broadcast spawning and pelagic larvae to copulation and direct development. However, the advent of next-generation sequencing technology and genomic analyses offers new potential to understand the natural and unnatural forces that are shaping biodiversity. In previous research, a multivariate seascape model was used to infer that urban runoff and sewage effluent are effective barriers to larval dispersal and effectively lower the genetic diversity a non-harvested species of sea star, Patiria miniata, across Southern California. Here, I expand this original analysis by adding data from a related species in Australia, utilizing a seascape analysis factoring in the five major sewage outfalls of Sydney. Transitioning from seascape genetics to seascape genomics, pooled RADseq is used to survey over 10,000 genetic loci for potential targets of anthropogenic selection in both species and to estimate how anthropogenic pollution is influencing the population connectivity of these two marine species.

Transdisciplinary Methodology for the Habitability, Validity and Adaptation Conditions in Neighborhoods in Vina Del Mar, Chile

Claudio J. Carrasco Aldunate. Escuela de Graduados Facultad de Arquitectura, Escuela de Construccion Civil Facultad de Ingenieria, Universidad de Valparaiso, Chile

This research addresses the problem the recovery of urban residential habitat in four neighborhoods in Estero de Renaca basin in Vina del Mar, Chile. It is stated that the deterioration of the neighborhoods in the city is mainly due to the lack of public integrated policies. A methodology to modeling the neighborhood's complexity is proposed. The habitability, neighborhood's validity and neighborhood's adapting capacity are considered because they would indicate its sustainable level. Social, economic and environmental variables that act on the definition of neighborhood, their validity and adapting are determined by a committee of experts that develop composite indicators of sustainability with these defined variables. Then the analytic hierarchy process (AHP) method is developed with community residents and Saaty's scale (1-9) is used. A mathematical model that integrates these composite indicators is proposed that enables the simulation of future scenarios considering the work of disciplinary experts and the resident community vision. In this process the different disciplinary languages that are involved in neighborhood definition are integrated This methodology brings together different disciplinary approaches to better understand techno-metabolic neighborhood's process. The neighborhood complex habitat and its landscape's metabolism process are modeled. Design criteria by

experts and community are used. It includes some aspects of urban metabolism currently not considered in similar studies and gives answer to how should be the generation and configuration of the neighborhood. Its minimum elements and the relationships between them are indicated. This transdisciplinary result promotes permanent habitability, validity and adaptation in the whole neighborhood.

Wildlife in a human-dominated world: no places left unaffected from infrastructural development?

Aurora Torres, Museo Nacional de Ciencias Naturales - Spanish National Research Council; Jochen A.G. Jaeger, Concordia University Montreal; Juan C. Alonso, Museo Nacional de Ciencias Naturales - Spanish National Research Council*

A decade ago, Kurt Riitters and James D. Wickham (2003) suggested that effects from roads may be the rule rather than the exception in the conterminous US. Since then, knowledge about connectivity metrics, roadless areas, and the effectiveness of defragmentation measures has significantly improved. However, we have missed a critical point that might help respond to the challenges from future developments, including roads: That is, a consistent estimation of the spatial extent of the effects from human structures on wildlife populations. Here, we measure proximity to human structures in Spain, a developed country still harboring a rich vertebrate fauna. We model their overall and habitat-specific areas of influence, based on functional response curves for birds and mammals. The imprint of human structures extends over more than half of all land area for birds (54.2%), whereas for mammals it covers almost all of Spain (97.9%). In addition, the response curves predict an average decline of about 50% in mammal numbers and 25% in bird numbers across Spain due to the influence of human structures alone, compared to an undisturbed situation, and human influence is still increasing. We conclude that the impact of human structures on wildlife has become massive and that the extinction debt of landscapes may be significant, particularly for wide-ranging mammals.

Land Use Change and Landscape Analysis of the Brazilian Caatinga

Samuel Kovach, Steven W. Seagle - Appalachian State University, Deep Gap, North Carolina, USA*

Land use change impacts range from collective global effects on climate to local degradation of ecosystem services available to humans. Consequently understanding regional land use change has many ramifications. In northeastern Brazil, the caatinga, a semi-arid scrub vegetation rich in endemic species, has undergone extensive loss and degradation due to increasing human populations, expansion of agriculture due to growth in irrigation, and recently infrastructure development for inter-basin transfer of water to support economic development. This research focuses on land use change over a 12440 km2 area of native caatinga in southeastern Pernambuco State along and north of the San Francisco River. Objectives include (1) detecting the degree and direction of land use change over the last twenty years, and (2) quantification of changes in landscape structure and examination of spatial variation in landscape structural changes. Not surprisingly, change analysis highlights the loss of caatinga vegetation cover, especially along the San Francisco River where irrigation has expanded both along and further away from the river. Transformation of landscape composition and structure varies from extensive alteration of composition (expansion of agriculture and urban/suburban) near the river, to increased complexity of structure (e.g., increased adjacency of caatinga and human land uses) further from the river, to spatially variable fragmentation of caatinga vegetation even further from the river. Quantification of this new spatial variation in landscape structure and composition provides a template for caatinga conservation, planning of ecosystem services, and evaluation of agricultural development impacts.

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Spatial-temporal Variation of Ecosystem Services in peri-urban area of Xiamen City, China

Quanyi Qiu, Qinghai Guo, Guoqin Zhang
Key Lab of Urban Environment and Health, Institute of Urban Environment,
Chinese Academy of Sciences, Xiamen City, China

Ecosystem services contribute to human well-beings. It is important to assess ecosystem services of natural ecosystems for people to utilize those ecosystems in a sustainable way. In urban area, human-caused landscapes changing always create spatial-temporal variation of ecosystem services. Especially in peri-urban area, the changes are significant. In this study, we used InVEST model to evaluate the magnitudes and spatial patterns of ecosystem services in peri-urban area of Xiamen City, China from 1990 to 2010. Three types of ecosystem services in this study were water conservation, erosion protection, and carbon storage. The impacts of land cover changes, population density, precipitation et al., in study area were analyzed using multiple regression analysis approach. The results showed that: between 1990 and 2010, urbanization had an obvious effect on land cover changes. The percentage of built-up area in peri-urban area of Xiamen City increased by 1000%. The percentages of forest land, crop land and wet land decreased by 0.29%, 42.02%, and 17.43%, respectively. And this has caused the changes of ecosystem services. The water conservation, erosion protection and carbon storage decreased by 3.13%, 23.1%, and 10.7%, respectively. The ecosystem services in study area weakened obviously between 1990 and 2010. The results also showed a distinctive spatial pattern of ecosystem services which was mainly related to the spatial distribution of different land cover types. It can be predicted that the decreasing trend of ecosystem services in study area will continue in the future, and we should use the ecological comprehensive treatment to slow down that trend.

Mean Absolute Deviation to compare maps of a continuous variable

Robert Gilmore Pontius Jr, Clark University; Rebecca Chapman, Clark University*

Mean Absolute Deviation (MAD) is an appropriate measurement to compare two raster maps that show the same continuous variable. We illustrate the method by comparing maps of global sea surface temperature for two cases: [1] different seasons in the same year, and [2] different decades at the same season. MAD is larger for case 1 than for case 2, because there is more deviation across the globe due to change of season than to change of decade. We separate overall MAD into components. The quantity component is the absolute value of the overall average of one map minus the overall average of the other map. The quantity component is smaller for case 1 than for case 2, which indicates global warming over decades. Case 1 has a positive deviation in the northern stratum and a negative deviation in the southern stratum, which causes a large stratum component. Case 2 has no stratum component because both north and south strata experience warming. Scientists should use the components of MAD, because MAD has properties that are more desirable than other frequently used measures, such as R-squared, correlation, and Root Mean Squared Error.

Do novel competitors shape species' response to climate change?

Jake M. Alexander, Institute of Integrative Biology, ETH Zurich; Jeffrey M. Diez, Department of Botany & Plant Sciences, University of California, Riverside; Jonathan M. Levine, Institute of Integrative Biology, ETH Zurich*

Climate change has direct effects on species' demography and indirect effects mediated by interactions with other species. Studies of how interactions may shape climate change responses have typically focused on extant communities, but novel interactions may be critical because species are shifting their ranges asynchronously with climate change. However, these effects of novel competitors have rarely

been studied due to challenges in predicting future species assemblages. We used steep elevation / climatic gradients in mountains to test of the importance of novel competitors because the novel competitors of future climates are found only a few hundred meters away. We transplanted focal alpine species and turfs containing intact plant communities along an elevation gradient in the Swiss Alps to simulate different scenarios for how the competitive environment for a species could change following climate change. Our experiment shows that plant performance can depend strongly on the identity of the community with which they compete. Growth and survival were reduced in the presence of competitors from lower elevation relative to their original community. However, performance was not significantly affected when we simulated scenarios in which the focal species migrate to track climate change and enter a novel high-elevation community. These results suggest that novel competitors may play an important role in shaping responses to climate change. In particular, persistence in the face of climate warming will depend on the rate of immigration of competitors from warmer areas, suggesting the need for process-based models that can account for impacts of novel competitors.

Predicting current and future bird species distributions with biotic interactions along elevational gradients

**Jill E. Jankowski, University of British Columbia, Canada Gustavo A. Londono, Universidad ICESI, Colombia Scott K. Robinson, University of Florida, USA Mark A. Chappell, University of California, Riverside, USA*

Tropical mountains harbor diverse ecological communities in part due to high species turnover generated by narrow elevational ranges. We investigate the importance of biotic factors in reinforcing elevational ranges of tropical birds to understand how such high species turnover is maintained and to better predict how climate change will affect species' ranges. We focus on interspecific competition, nest predation and habitat specificity, biotic interactions that have both specific and widespread effects on species range limits. It has long been thought that parapatric distributions between closely related species along elevational gradients are maintained by competitive interactions. We explore the extent to which interspecific competitive interactions underlie elevational replacements by comparing results from heterospecific song playback experiments conducted across Neotropical regions. Nest predation also plays an important selective role in shaping tropical avian life history traits and ecology, although the intensity of predation varies with elevation. We examine how variation in nest predation rates and predator frequency influences community-level patterns of species turnover. Finally, many tropical species are specialized to particular habitats, and as a result, have patchy or restricted distributions. Empirical data show that biotic interactions can have important species-specific and community-level consequences. Tropical mountains are expected to undergo extensive transformations as species respond to changing climates. Thus, our goal is to combine detailed surveys of species distributions with robust empirical data on biotic interactions to design models that accurately predict current species distributions and make reliable predictions for how ranges can be expected to shift under future climate change scenarios.

Soundscape Patterns related to a Landscape Development Intensity Index

Jenet Dooley, University of Florida Department of Environmental Engineering Sciences; Mark Brown, University of Florida Department of Environmental Engineering Sciences*

Noise from energy intensive processes radiates outward, introducing noise disturbance into neighboring areas. The Landscape Development Intensity Index (LDI) uses the non-renewable energy use of surrounding land uses to predict the ecological condition of a specific point or area. Using the LDI within a soundscape context allows surrounding land use to be thought of as a source of sound energy flux.

This study looked at sound recordings (n=60) taken within six different land use types (industrial, conservation/natural, neighborhood, shopping center, park, downtown/city center) in North Central Florida (USA). The sound recordings were described using their power spectral densities and soundscape metrics including Equivalent Continuous Sound Level, acoustic entropy, and acoustic diversity. The LDI score for the recordings' locations and the recording's properties were compared within and between land use categories. Results indicate that there is a large range of land use intensity within land use type. Further, as surrounding land use intensity increases, overall sound levels increase and low frequency sounds dominate the sound spectrum. This study also helps define generalized land use-specific soundscape characteristics along a human influence gradient. In addition, the ability to adjust the scale of the LDI calculation provides insight about the area of impact for a sound recording.

Food Quality and Landscape Quality as a Tool to Valorize Historical Landscapes and Biocultural Diversity

Mauro Agnoletti, Antonio Santoro, Martina Tredici -University of Florence, Laboratory for Landscape and Cultural Heritage*

Landscape features resulting from food production can be interpreted as the forms that the man , in the course and for the ends of his agricultural activity consciously and systematically imposes to the natural basis creating a cultural landscape. In this respect every typical food has it's own landscape. Landscape features resulting from food production provide particularly ingenious solutions to environmental or social constraints, such as land use mosaics, irrigation/water management systems, terraces, particular ecosystem adaptive architecture, which provide for resource conservation/efficiency or habitats for valued biocultural diversity, recreational values, collective or non commercial valuable uses. The protection of traditional practices and the links between the quality of the food and the quality of the landscapes can also contribute to the economic development of the rural territory. The food production model of the future should try to integrate all these aspects, as also proposed by FAO GIAHS and in the Universal EXPO 2015 occurring in Milan (Italy). The paper explores some case studies from several parts of the world, including the Italian National Register of Historical Rural Landscapes. Spatial and temporal scale, as well as the structure of the industrial and traditional landscape mosaics will be discussed.

State-and-transition simulation modeling of future land use scenarios

Tamara S. Wilson, U.S. Geological Survey, Western Geographic Science Center, Benjamin M. Sleeter, U.S. Geological Survey, Western Geographic Science Center*

Human use and alteration of earth's land surface, combined with global climate changes, will pose considerable challenges to biodiversity resilience and resource availability. Species adaptive capacity is limited by habitat availability, while resource extraction is limited by finite supply and ever-increasing demand. The development of spatially explicit models of future land use driven by empirical, historical land use and land cover (LULC) change data are necessary to explore plausible LULC futures and potential mitigation strategies. We developed the Land Use and Carbon Scenario Simulator (LUCAS) state-and-transition simulation model to model spatially explicit LULC change scenarios at 1 km for various ecoregions in the western United States. Each LUCAS implementation utilized different historical empirical land change information to drive estimates of future change, as well as future LULC scenarios derived from the Intergovernmental Panel on Climate Change's (IPCC) Special Report on Emissions Scenarios (SRES). We present two examples of LUCAS implementation: 1) for ecoregions in the Pacific Northwest modeled from 2000 to 2100 and results explored in terms of LULC conversion threats near protected areas and 2) for ecoregions and counties in Mediterranean California with agriculture water use tracked for each scenario. Mitigation scenarios were developed and tested for the California model,

including two drought scenarios and three land conservation scenarios. Resulting scenarios of future LULC are useful for visualizing alternative futures, examining potential management approaches, and enabling more informed decision-making.

Part II Closing Discussion: Best practices and strategies for integrating geospatial techniques into environmental planning across multiple scales

Moderator - Henry Bulley; Discussants - Christine Furst (Center for Development Research, University of Bonn, Germany)Shuaib Lwasa (Makerere University, Uganda)

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Developing a GIS based model of changes in land use and Nitrogen flows - an interactive model for stakeholder involvement and decision-making

Peter StubkjÃ¦r Andersen; Andreas Aagaard Christensen; HelÃ¨ne Draux; Henrik Vejre; All: Department of Geosciences and Natural Resource Management, University of Copenhagen, Denmark*

Recent studies suggest that the planetary boundary of the biogeochemical flows of Nitrogen (N) has been exceeded leading to severe consequences on ecosystems, including eutrophication, loss of biodiversity, and ecosystem mal-functioning. This call for actions to invert the negative impacts; land use change models may assist in the formulation of feasible landscape futures. Problems related to excess N are mainly present in agricultural landscapes in North-America, Southeast Asia, and Northern Europe. In Denmark several studies of N flows have been conducted and N mitigation actions have been identified, several of these being related to land use changes. Consequently, intended land use changes can be modelled and the N response calculated. This is done through a GIS integration of an N leaching model that includes the parameters: land cover type, crop rotation and fertilizer regime, soil type and hydrology, and climatic conditions. The scenarios used have been formulated by local stakeholders with the aim of modelling options of future land management with special focus on N. Thus, with the model we combine a data-based approach with a process-based approach, drawing on the advantages from both. The goal is to achieve possible win-win solutions that lead to benefits for both the environment and the local food production.

Does Increasing Crop Heterogeneity Benefit Species Diversity? Cross-taxon Congruence Across a Gradient of European and North American Agricultural Regions

Clelia Sirami, Dynamiques et ecologie des paysages agriforestiers, Institut National pour la Recherche en Agronomie, Toulouse, France; FarmLand Consortium, (http://www.farmland-biodiversity.org/index.php/en/people/consortium.html)*

Agricultural landscapes occupy nearly 40% of the earth's terrestrial surface and play an important role in providing habitat for wild plants and animals. Over the last half century, intensification of agriculture has resulted in losses to biodiversity. Landscape heterogeneity has been proposed as a key tool in conserving farmland biodiversity. Indeed, agricultural landscapes which contain higher amounts of semi-natural habitats are known to be associated with higher species diversity. However, agricultural landscape management is currently facing major challenges. Current policies either aim at increasing the proportion of semi-natural elements, which requires taking crop area out of production and is often not feasible, or focus on a particular group of species, which may lead to the decrease of other species. It has been suggested that, in addition to the area of semi-natural habitats, the spatial heterogeneity of the cropped lands may be positively related to species diversity through landscape complementation processes. The FarmLand project has tested this hypothesis on seven taxonomic groups across eight

regions of Europe and North America. Surveys were conducted in 340 landscapes located along two independent gradients of crop compositional and configurational heterogeneity measured as crop diversity and crop total border length. We compared species richness and total abundance of seven taxonomic groups in a total 1337 fields. Results to date suggest that greater crop or landscape heterogeneity does not necessarily benefit species diversity and highlight that effects of heterogeneity can be complex and variable across taxonomic groups and agricultural regions.

Big Questions and Interdisciplinarity in Research Linking Food Security, Livelihoods and Ecological Functioning in Coupled Human and Natural Systems

Organizers

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Introduction to Symposium

Tom Miewald

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How herbivores and their two-way interactions with the vegetation mediate the transitions between biomes

Isabelle Boulangeat, Universite du Quebec Ã Rimouski; Matthieu Leblond, Universite Laval; Tanguy Daufresne, INRA; Dominique Gravel, Universite du Quebec Ã Rimouski*

Although it is widely recognized that ecological interactions are important to maintain ecosystem properties, their role in limiting species ranges is still poorly understood. To explain and forecast changes in biomes limits, current models focus on vegetation dynamics and usually account for a small number of species whilst ignoring other trophic levels. In particular, they rarely integrate large herbivores as key drivers, and even less the reciprocal effects of vegetation on herbivore populations. Along a climatic gradient featuring the transition between temperate and boreal forests up to the tundra, we propose to analyze how accounting for a two-way interaction between large herbivores and the vegetation is likely to modify (1) the steady-state distribution of main vegetation types and (2) the dynamic response of the vegetation to climate change. We combined a state transition model of the vegetation with a meta-physiological model of the dynamic of herbivore populations. Interactions were based on consumer-resource mechanisms including resource selection depending on availability and mediation by climatic conditions. We also accounted for the protective effect of forest habitats. Our analyses suggest that herbivore populations, through complex interactions, might be a significant factor limiting species ranges and defining ecotones. We also find that the distribution of vegetation might not be directly limited by physiological constraints related to climatic conditions, but instead by interactions with large herbivores. In a context of climate change, these results suggest that it is not possible to anticipate the response of the vegetation whilst ignoring its interactions with other trophic levels.

The role of cultural ecosystem services for governance in social-ecological systems (South Africa, Madagascar)

Maria Tengo and Vanessa Masterson, Stockholm Resilience Centre*

Forests have multiple meanings for local people. In addition to supplying food and material, they also generate cultural values associated with species and landscape components. In this paper, we argue that such cultural values of forest may play a greater role for local decision-making about forest use and

management than is often acknowledged. Using a social-ecological systems approach and empirical data from case studies in Madagascar and South Africa, we discuss the role of cultural ecosystem services in governance of forest ecosystems. In Southern Madagascar, in spite of high pressure on forest resources, forest patches scattered across the landscape are managed primarily to maintain cultural values of heritage, spirituality, and identity. Our study shows that values are secured and maintained through local taboos that also protect important supporting ecosystem services in the landscape. In the former Transkei, Eastern Cape of South Africa, anthropological research has identified spiritual values associated with the local forest. Here, we show how local values are mobilized and negotiated in the co-management process of a forest reserve. Based on the findings, we discuss the potential implications of excluding cultural values when designing forest governance. Greater recognition and understanding of cultural ecosystem services can provide a useful entry point for identifying and developing synergies in governance of multiple values in biocultural or social-ecological systems.

Time to expand biodiversity spectrum: landscape and culture as levels of interest

Emilio PADOA-SCHIOPPA, University of Milano-Bicocca; Telmo PIEVANI, University of Padova*

Traditionally, conservation biology explains the term biodiversity as "the variety of life at different levels: genetic, specific, ecosystem / habitat". We suggest to expand this spectrum, adding two more levels: landscapes and cultures. Landscapes, in the traditional definition of a system of ecosystems, are the higher level of biodiversity, and in several examples the results of interactions between man and environment, and can have control on lower levels (i.e. mountain landscapes, Mediterranean islands). Culture, in a simple way, may be defined as an amount of information inside an animal population that may be non-genetically transferred intra and inter-generations, through learning, imitation and sharing. There are several examples of cultural transmission and diversity, not only in human populations but also in primates, birds and other vertebrates. As well as we agree that landscapes and cultures may be identified, they can be mapped and they may become part of conservation projects: as an example chimpanzee (Pan troglodytes) conservation needs to take into account the different cultures of the populations widespread in Africa. This perspective opens a new research program, where key questions may be summarized into: 1) How to define and map cultures and landscapes? 2) What are the relationships among all biodiversity levels? 3) Is there any common pattern in the evolution of biological and cultural biodiversity? In our presentation we provide examples, from mountains systems (Himalaya, Alps, Andes) to primates cultures (Africa, Asia), and we propose a research program that aims to link local case studies into a broader framework.

Carbon sequestration of global cement materials-The human disturbance impacts on carbon sequestration processes.

Fengming Xi, Institute of Applied Ecology, Chinese Academy of Sciences; Zhu Liu, Sustainability Science Program, John F. Kennedy School of Government, Harvard University; Dabo Guan, School of International Development, University of East Anglia; Philippe*

Coupled human-environment systems showed disturbance on landscape processes. Global carbon sinks and their potentials are important to future atmospheric carbon dioxide concentration and climate change. Organic carbon sinks from global terrestrial ecosystem are widely recognized, while terrestrial inorganic carbon sinks caused by human activities are unknown. Here we show accumulative carbon sink of 5.55 Petagram Carbon (Pg C) (2Ïƒ=Â±10%) in cement materials used in construction activity between 1900 and 2013. The sinks are caused by alkaline cement carbonization chemical reactions that remove CO2 from ambient environment and store carbon into stable calcium carbonate minerals. Our results showed annual carbon sink is increasing with global cement consumption. The mean carbon sink

has been more than 0.10Pg C yr-1 since 1995 and up to 0.29 Pg C yr-1 in 2013. This represents an amount equivalent to 57.7-76.0% of CO2 released during the cement industrial process re-absorbed in cement containing materials within 100 life cycle assessment years in the building service, demolition, and dumped and recycled cement materials. The actual annual CO2 emission from the cement industrial process is overestimated more than 50%. The cement material carbon stock and sink flux should be included in global and regional carbon budgets, especially urban carbon cycle.

Climate change, fire and timber harvest in forests of the Oregon Coast Range

Megan K. Creutzburg, Robert M. Scheller, Melissa S. Lucash - Dept. Environmental Sciences and Management, Portland State University

Forests of the Pacific Northwest provide a wide array of important ecosystem services, including wildlife habitat, recreation, soil protection, clean air and water, and timber production. As climate changes, these ecosystem services may face multiple threats, including physiological stress, susceptibility to insects and disease, and potential for catastrophic wildfire. We used the LANDIS-II forest simulation model to project the long-term impacts of climate change, wildfire and timber harvest across two million acres of forests in the Oregon Coast Range. The Coast Range is comprised of a mosaic of public and private land ownership that is managed for a wide range of goals, resulting in highly varied management practices and stand conditions. We explored multiple future scenarios, including climate change projections encompassing much of the likely range of future climatic conditions, and management scenarios designed by a group of stakeholders in the region. Simulations suggest that climate change is likely to increase forest productivity and carbon storage over the next century as warmer winter temperatures allow greater conifer production in cooler months, but that these gains may be offset by increased risk of wildfire. Current levels of timber harvesting allowed carbon to accumulate on federal and other protected lands while allowing intensive harvesting on private industrial lands. Alternative scenarios of timber harvest demonstrated multiple approaches for maintaining carbon storage and species diversity under climate change.

Alien tree species invading European landscapes: the case of black locust in north-eastern Italy

Tommaso Sitzia, University of Padova, Department of Land, Environment, Agriculture and Forestry; Thomas Campagnaro, University of Padova, Department of Land, Environment, Agriculture and Forestry; Serenella Nardi, University of Padova, Department of Agro*

Invasive alien species are well-known for expanding within different landscapes. Currently, in the EU a new regulation on invasive alien species entered in force on 1 January 2015 thus calling for a raise of awareness on such topic. Black locust (Robinia pseudoacacia L.), a nitrogen fixing species, is among the most widely spread alien tree species in Europe. In north-eastern Italy it invades forest and open habitats important for native biodiversity. The invasion of abandoned areas in hilly landscapes may lead to the homogenization of vascular plant communities of native secondary forests. Here we investigate relationships between black locust invasion, landscape mosaic, soil composition and vascular plant biodiversity. Finally, we recommend further research and management measures to limit black locust spread and impacts supporting the need of embedding these measures within forest landscape planning.

Modeling Olive-sided Flycatcher (Contopus cooperi) habitat across post-fire boreal landscapes of Ontario, Canada

Andrea Clouston, Wildlife and Landscape Science and Technology, Environment Canada; Elyse Howat, Canadian Wildlife Service, Environment Canada; Jason Duffe, Wildlife and Landscape Science and Technology, Environment Canada; Jon Pasher, Wildlife and Lands*

The Olive-sided Flycatcher (OSFL) is a migratory bird that is listed as Threatened under the Species at Risk Act in Canada. A substantial proportion of the Canadian breeding population is sparsely distributed throughout Ontarioâ€™s boreal forests where access is logistically challenging, and detailed species distribution information is incomplete. In order to address these challenges, this work applied a multi-scale landscape approach to predictive habitat modelling with the goal of informing forthcoming critical habitat identification and other federal conservation efforts. Using expert knowledge about OSFL ecology and a high-quality occurrence dataset from targeted surveys of post-fire boreal landscapes in Ontario, we created landscape structure variables to describe suitable edge habitat combined with fire history and hydrology information derived from satellite land cover and GIS data inventories. We then generated Maxent models at multiple scales and used species-specific model tuning to optimize model performance. We expect this modeling approach will be useful in broader-scale, national critical habitat mapping where detailed species or habitat data are not available, which is a likely scenario for many remote locations of Canada. Future research will also investigate multi-scale models and other robust habitat modeling approaches in order to exploit more data-rich geographic regions.

Scaling species' niches to predict species' distributions

Jennifer Fraterrigo and Stephanie Wagner, University of Illinois; Robert Warren, State University of New York College at Buffalo*

Hierarchical niche relations offer a tractable framework for addressing the scale-dependent effects of abiotic and biotic processes on species distributions and form the basis for current approaches to species distribution modeling. A key prediction of this model is that the effects of biotic interactions will be averaged out at broader scales - an idea termed the Eltonian noise hypothesis (ENH). I present the results of a study that (1) tests hypotheses about hierarchical niche relations and Eltonian noise by quantifying regional variation in local niche relations and (2) assesses the role of macroclimate in structuring this variation, using a non-native invasive grass, Microstegium vimineum, in its introduced range. Consistent with the Eltonian noise hypothesis, we find that local biotic effects vary across the region. Macroclimate explains a significant amount of variation in local biotic effects, which suggests that biotic interactions are embedded in macroscale signals. A positive relationship between site-specific slope estimates relating M. vimineum performance and herbaceous plant biomass and growing season precipitation suggests that biotic interactions suppress M. vimineum in drier climates but have little effect in wetter climates. By contrast, local relations with abiotic covariates are similar across the region. The influence of macroclimate on local biotic interactions could explain contradicting evidence for ENH. Moreover, similar modeling approaches may be useful for identifying the macroclimatic conditions under which the accuracy of local predictions of species distributions will require information about biotic interactions.

Change of perspective. Expedient tools for landscape reconnaissance.

Joerg Rekittke, National University of Singapore

The act of reconnaissance is a fundamental part of every landscape design process. The more the designer turns out to be able to bring - to studio or office - a comprehensive set of information and data, the more she will be able to get an idea and a picture of the site of intervention. The coeval designer has an increasing number of adjuvant tools at her disposal. The fieldworker profits from potent tools for

measurement and documentation. Landscape architectural fieldwork in dense, crowded and often hardly accessible urban and mega-urban environments is an ardous undertaking that widely has to be conducted on foot. This intrinsic constraint necessitates light and portable tools. Landscape fieldworkers must be prepared to roam as backpackers, they have to be able to carry all their equipment in the field. In the ideal case, every student or faculty should be a kind of mobile, fully operational work unit, a fully equipped team worker who, in case of need, would be able to function as a lone fighter. We can profit from the mobile nature of standard survey equipment as well as from the trend towards a multitude of hand-held and flying devices for an increasing range of applications.

Anticipating connectivity needs for species in a changing climate

Joshua Lawler, University of Washington; Caitlin Littlefield, University of Washington; Brad McRae, The Nature Conservancy*

Improving connectivity is one of the most-often recommended adaptation strategies for conserving biodiversity in a changing climate. However, it is not clear whether connecting today's habitats for today's species will provide the connectivity that is needed in the future. Here, we project climate-driven movement routes for 366 terrestrial vertebrate species in western North America. We identify key corridors for, as well as potential barriers to, movement based on multiple future climate-change projections. We then compare these results to more traditional connectivity analyses based on current species distributions and habitat patterns. Although some of the corridors identified by more traditional, static, connectivity-modeling approaches coincide with areas of projected climate-driven species movements, our results indicate that facilitating species' range shifts will require additional planning and connectivity-modeling approaches that specifically take climate change into account.

Landscape properties influence the resistance, resilience and stability of avifaunal communities during climatic extremes

*Dale G. Nimmo, Deakin University; Angie Haslem, La Trobe University; James Q Radford, Bush Heritage Australia; *Andrew F Bennett, La Trobe University.*

Worldwide, ecosystems increasingly are experiencing multiple, interacting disturbances. In human-dominated landscapes, the persistence of species and provision of ecosystem services can be enhanced by strategic management of landscape structure; but could such management also assist biodiversity to cope with the additional effects of extreme climatic events, such as drought? We surveyed woodland bird communities in 24 landscapes (each 100 km2) in south-eastern Australia near the beginning (2002-03), middle (2006-07) and after (2011-12) a record-breaking drought. We quantified the resistance, resilience and stability of the avifauna to the decade of drought and related these measures to properties of the study landscapes, including the extent of native wooded vegetation, configuration of vegetation, land-use composition, landscape productivity and geographic context. The productivity of landscapes, represented by the overall amount of streamside vegetation on moister fertile soils, was the strongest driver of the resistance, resilience and stability of avifaunal richness to severe drought. Woodland bird communities in agricultural landscapes with a larger total area of streamside vegetation had greater resistance to drought and greater stability over its duration. Land managers cannot prevent extreme climatic events like drought, but they can mitigate their effects by landscape management. Protecting, restoring and expanding native vegetation in productive areas - along streams, drainage lines and floodplains - has the potential to build climatic refuges, and thereby enhance the resistance of biota to climatic extremes. However, a net decline over the entire study suggests this will not, by itself, arrest biodiversity decline during periods of extreme drought.

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Data-based vs process-based mapping of ecosystem service change

Nynke Schulp, Jasper van Vliet, Emma van der Zanden, Peter Verburg - University Amsterdam

Several international and European policies aim at stabilizing or enhancing the provision of ecosystem services. To design and evaluate such policies, spatially explicit indicators for the provision of ecosystem services are used. These comprise indicators to quantify the current state of ecosystem service provision, as well as indicators that project future states of ecosystem service provision. These are most commonly based on projections of future land use change and additional biophysical input data. There are concerns on the reliability of such ecosystem service indicators. It has been demonstrated that different indicator definitions and methodologies result in highly varying quantifications for the same ecosystem service. We explored how such uncertainties propagate into policy recommendations. Policy scenarios that impact the future land use of Europe's rural al areas were simulated using a high-resolution land use change model. The scenarios are based on actual or foreseen EU policies or are actually used for EU policy support. Based on the land use change scenarios, changes in provision of a set of ecosystem services were simulated using different models. A data-driven model, an expert-based model and a model of intermediate complexity were used for each service. Changes over time in each scenario were quantified and were compared with the differences among the different models. The results indicate that the choice for a specific model will influence policy recommendations. This calls for a careful model and data selection in modelling studies for policy support.

Outbreak phase and fragmentation: effects of forest fragmentation on forest tent caterpillar mortality through a full population cycle

Jens Roland, Department of Biological Sciences, University of Alberta, Edmonton*

Rates of parasitism by insect parasitoids, and predation by birds, attacking forest tent caterpillar were evaluated from 109 sites ranging in degree of forest fragmentation. Estimates of parasitism of larvae and pupae, and predation on pupae were estimated through more than a full population cycle from 1993 through 2009. Parasitism is higher in more contiguous forests during the increase and peak phases of the cycle, but the guild of parasitoids differs depending on absolute host population density. Predation by birds, in contrast, is higher in more fragmented stands, but only during the increase phase. Consequences of these patterns for cyclic dynamics of tent caterpillar are discussed.

3M - three main problems of ecosystem services application in land-use planning

Malgorzata Kowalczyk, Institute of Spatial Management and Housing, Warsaw (Poland)

The concept of ecosystem services and its implementation is widely discussed by academics, and various interest groups, which results from its increasing popularity. As shows recent research there are some possibilities to incorporate the concept of ecosystem services into projecting the effects of policy choices (Carpenter et al. 2009; Tallis, Polasky 2009) however, the use of ecosystem services concept in real-life decision making processes is still limited (Gianeletti 2012). There are at least three main problems related to application of ecosystem services into land use planning, which can be defined as 3M: 1. 'multiscale', 2. 'multiuser' 3. 'multiservice' The 'multiscale', results from the fact that ecosystem services are provided and used at different spatial scales. One of the problems related to spatial scales is the difference between the area which providing ecosystem services and the area of using them. The other problem related to the spatial scale is identification and signification of ecosystem services depending on the planning tiers (national, regional, local). One of the most important features of the ecosystem services concept is that its joins environment and its users, which means that there are no services without demand (Kowalczyk, Kulczyk 2012). The second problem is 'multiuser', which indicates

a need for detailed social research to describe which services are demanded. The third problem is 'multiservice', which is related to using of ecosystem services and to the fact that one ecosystem can provide different services.

Sensitivity to parameters of tree extraction algorithms from LIDAR

Bogdan Strimbu, Louisiana Tech University; Dan Nitu, Forest Research and Management Institute; Marius Dumitru, Forest Research and Management Institute; Liliana Radulescu, Forest Research and Management Institute; Gheorghe Marin, Forest Research and Mana*

Performance of tree extraction algorithms from LIDAR point cloud depends on accurate identification of parameters required by the algorithm. In most cases extensive ground measurements are needed to identify the parameters, which diminish their usage in practical applications. The objective of the present research is to assess the sensitivity to parameters of two algorithms (i.e., one new, based on graph theory, and one based on watershed segmentation) used to identify individual trees from LIDAR point cloud. The new algorithm delineates trees by clustering a weighted graph whose vertices correspond to local maxima. The weight of an edge is a function of several attributes relating two trees (i.e. number of common patches or height difference). The vertices are clustered by keeping only a unique edge (e.g., most weight) pointing at any vertex, which separates the graph into a set of connected components. An individual tree is represented by a connected component. The two algorithms were tested using a LIDAR data with 30 points/m2 from center Louisiana on three types of spatial complex stands: one homogeneous (i.e., young loblolly pine plantation), one heterogeneous (i.e., unmanaged uneven-aged stand with mixed species pine -hardwood), and one intermediate (i.e., old loblolly pine plantation). The new algorithm outperforms the watershed algorithm, irrespective stand complexity. Watershed segmentation algorithm exhibits reduced sensitivity to parameters, but the results were worse than most sets of parameters needed by the new algorithm. The new algorithm is a better alternative to watershed algorithm even when parameters are not accurately estimated.

Planning for landscape connectivity: the prioritised action frameworks for Natura 2000 in the European Alps

Thomas Campagnaro, University of Padova, Department of Land, Environment, Agriculture and Forestry; Tommaso Sitzia, University of Padova, Department of Land, Environment, Agriculture and Forestry*

The Natura 2000 network is formed by sites selected to protect species and habitats listed in Annexes of the European Birds and Habitats Directives. This network is the most relevant biodiversity conservation effort in Europe. To ensure and plan for nature conservation, the Habitat Directive foresees the possibility of identifying Prioritised Action Frameworks (PAF) either at the national or regional level. PAFs aim at identifying priority conservation needs and linking them to funding possibilities. Planning and setting priorities should consider landscape connectivity by targeting fragmentation and barriers. In the alpine area, Natura 2000 sites may be considered well connected at least between different European countries. Abandonment of remote areas and construction of new infrastructures in valleys and piedmont areas cause barriers leading to changes in traditional landscapes and decreasing landscape connectivity. Hedgerows and river corridors have the potential to connect Natura 2000 sites. Conservation measures should encompass an array of different management actions providing heterogeneous landscapes. Nevertheless, planning and cooperation between regions should be improved to enable cross-boundary connectivity in-light of future issues. Future research and management should give increasing attention to long-distance connectivity (alps-plains), climate change and the spread of invasive alien species.

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Forward steps to improve robustness in case study based ecosystem services research

Walz, Ariane, Earth and Environmental Science, Univ. Potsdam; Paterson, James, School of Geosciences, University of Edinburgh; Schmidt, Stefan, Helmholtz Centre

Ecosystem Service (ES) research has produced a large number of empirical case studies across a diversity of heterogeneous landscapes and scales to demonstrate the potential of the ES concept. Meta-analyses building on numerous coded case studies are an increasing means to attain more general knowledge about larger-scale landscape patterns and process driving ES provision. To ensure meaningful meta-analysis, the selection of criteria for inclusion in reporting and the quality of information provided are crucial. We further extended the blueprint concept for reporting from case studies originally based on Seppelt et al. (2011). We elaborated criteria through quantitative reviews of effectiveness and efficiency of ES-based measures, and levels of evidence approached. This blueprint was applied in 12 current studies, which were then integrated to an existing SynES database, currently holding155 cases. We analysed the resulting database to test (a) whether the extended blueprint yielded statistically more robust findings, and (b) how the twelve case studies compared with previous studies (e.g. if they filled knowledge gaps). Our results show how a rigorous reporting scheme for case studies in ES research improves analytical knowledge generation through meta-analysis. The focus studies cover a range of heterogeneous ecosystems (marine to mountain) and scales (local to global). They constitute primary studies, intensely collaborated with stakeholders, and fill some knowledge gaps on cultural ES. Different to most previous studies, these provided information on the robustness of the research and illustrate the strong operational potential of the ecosystem service concept for practical biodiversity and ecosystem management.

The intertidal soundscape in Gitga'at Territory, Hartley Bay, British Columbia

Max Ritts, University of British Columbia, Vancouver, BC

Soundscape Ecology has emerged as a dynamic and versatile component of landscape ecology research with applicability across a range of site conditions and contexts. This study examines the soundscape in an intertidal area within an Indigenous Territory. I present a soundscape ecology collaboration with the Gitga'at Nation of Hartley Bay, BC. Since 2004, the sanctity of Gitga'at Territory and its people has been threatened by proposed industrial development, and transnational shipping in particular. The objectives of the study were twofold: first, to collect baseline acoustic recordings in the intertidal zone of the Territory for one year in areas potentially impacted by industrial development (e.g. tanker traffic). Second, to utilize collaboration principles that advanced Gitga'at capacities and implicated our findings within the Nation's broader efforts to contest unlawful shipping projects from entering their Territory. Eight song meters were placed in inter-tidal areas along the proposed shipping channel. Recordings were made at 15 minute intervals. Recordings were collected with the assistance of the Gitga'at Guardians and were subsequently uploaded into a digital library where soundscape metrics were computed for each recording. The patterns of the soundscape in the intertidal ecosystem will be illustrated and I will reflect upon the successes and challenges of our efforts and what they propose in terms of a politically engaged soundscape ecology.

Testing the 'small island' versus 'sample area' effects: the case of Thousand Island Lake, China

Maxwell C. Wilson, Arizona State University

Since MacArthur and Wilson's landmark development of island biogeography, land-bridge islands have been looked to as analogues for studying the impacts of habitat loss and fragmentation. However, in

recent years many of the premises of MacArthur and Wilson's original findings have come into question. Specifically, a new class of fragmentation research questions the existence of the "island effect," which posits that samples taken from small islands should contain fewer species than samples of equal size taken from large islands. In contrast, the "sampled area effect" suggests that samples of equal size should have an equal number of species, regardless of the size of the island from which they originate. Here we test these two hypotheses using woody plant species richness across twenty-nine islands of Thousand Island Lake, China, a large land-bridge island system in south-east China. We find that the observed species richness in samples aggregated from small islands are nearly identical to the observed species richness in samples of equal size taken from larger islands, suggesting that species richness is driven by the sample area effect, not patch size or landscape configuration. Further, when large islands and collections of small islands of equal size are compared collections of small islands contain more species than a single large island of equal size. These results cast doubt on the island effect and support the sampled area affect. Further, these results add additional support to other compositionally based hypotheses, such as the Habitat Amount Hypothesis.

Assessing the vulnerability of forested landscapes to climate change

Eric J. Gustafson, US Forest Service, Northern Research Station; Melissa S. Lucash, Portland State University; Robert M. Scheller, Portland State University; Sturtevant, Brian R., US Forest Service, Northern Research Station

Global changes have the potential to render obsolete many of the empirically-derived relationships used to predict forest dynamics. To make landscape models more robust to novel environmental conditions such as climate change, the processes simulated by them must increasingly be directly linked to the fundamental environmental drivers that are changing. The Century-Succession extension of the LANDIS-II forest landscape model explicitly links species growth rates to climate, soil water and nutrients, allowing species to compete, disperse and establish across a landscape through time. Disturbance extensions concurrently simulate the disturbance processes that structure forests at the landscape scale. We used this modeling framework to assist the Chippewa National Forest (Minnesota USA) to conduct a climate change vulnerability assessment for a large landscape that includes the entire ecological subsection in which the Forest is located. The results are being used within the regional Climate Change Response Framework to help the Forest work with local stakeholders to develop management strategies to mitigate the vulnerabilities identified. The model also provides the ability to assess the likely effectiveness of the proposed strategies.

Spatial Identification of Landscape Ecological Security Pattern Based on Human Ecological Demanding: A Case Study in Beijing-Tianjin-Hebei Region

Jian Peng, Peking University; Liqing Zhang, Peking University; Jiansheng Wu, Peking University*

Construction of landscape ecological security pattern can effectively safeguard the urban ecological security, which is one of the key hotspots in the landscape ecology research. But source recognition always only consider the ecological importance of ecological patch itself, ignoring the structural relationship in the whole pattern and the ability of providing service to human; and the set of ecological resistance surface mainly based on land use types, which covering the difference between the space under the same type of land use. In this case study in Beijing-Tianjin-Hebei area, ecological importance is assessed through biodiversity services, soil retention and water security. The importance of ecological patches in the whole pattern is focused using landscape connectivity analysis. Human ecological demanding is quantified by considering the social condition and the distance from patches to the population gathering place. It is nighttime light data used to revise ecological resistance surface based

on land use types, and then the corridors between ecological sources is identified according to the minimum cumulative resistance model. The results showed that, the total area of ecological source is 36246.25km2, accounting for 21.26% of all ecological land area of Beijing-Tianjin-Hebei area. The source is mainly located in the west of Beijing and southwest of Chengde, and the rest is located in the west of Beijing-Tianjin-Hebei area and the coast of Bohai sea beach. The rank of the source proportion is water > wetland > forest > grassland> farmland > unused land, the rank of source area is farmland > forest > grassland> water > unused land > wetland. Almost each nature reserve distributes within the range of source, indicating the recognition result is reliable. The total length of the potential corridors is about 12654.38km, of which the length of the key corridors is about 1545.52km. Relatively speaking, the key corridors are facing greater pressure from human activities, which need far more attentions. The present river corridors throughout the region together with potential corridors constitute the ecological corridors.

Land degradation in Central Asia: current trends and institutional aspects

Iskandar Abdullaev, Executive Director, Regional Environmental Center for Central Asia (CAREC)

Central Asia is home for 60 million inhabitants, almost half of which are living in rural areas and mainly sustaining their livelihoods via small, subsistence farming. Therefore, land productivity and quality is a key for food security, prosperity of major part of Central Asia's population. Since, de-collectivization in Central Asian states has established different land ownership regimes and land management institutions. Therefore, there is no unique system of land management in Central Asia in spite of soviet legacy, although institutional past-dependency in land management is present in different degree in all countries of the region. Most common in Central Asian countries is the land degradation. Since the land distribution of 1990's and formation of new agricultural policies, annually 50 000 ha irrigated land are going out from agricultural use due to the salanization, high ground water levels and desertification. Although, land ownership regimes and agricultural policies are different, currently none of the Central Asian states can be an example for productive land management. It is crucial to understand core reasons for recent failures and problems on land management in the region. Therefore, comparative analysis of land and water governance regimes in different countries of Central Asia sheds light on problems of land management. The author is comparing current water and land governance approaches in 5 states and provides in depth analysis of new polices on land management. One of the major findings of this study is that strict state control or full withdrawal from agriculture does not provide sustainable solutions to the land management problems. Smart approaches, which couples state's regulatory role with innovative socio-economic incentives could bring more productivity and less degradation into land management. The results of the study are authors observations and research of the issues during the last 20 years.

Afforestation planning in rehabilitation of degraded agricultural landscape in Central Asia: An interdisciplinary approach

Prof. Dr. Asia Khamzina, University of Bonn, Center for Development Research (ZEF); Begzod Djalilov, Center for Development Research (ZEF); Dr. Utkur Djanibekov, University of Bonn, Institute for Food and Resource Economics; Dr. Olena Dubovyk, University*

Climate change is likely to exacerbate water scarcity and salinity-induced land degradation thus hampering economic development in irrigated agroecosystems of Central Asia, particularly in downstream regions proximal to the Aral Sea Area. We assessed the option of integrating forestry practices on degraded cropland in the lower Amudarya Basin for a mitigation of and adaptation to the environmental change. The analyses included remote sensing based detection of degraded landscape parcels, a subsequent multi-criteria assessment of the land and tree species suitability for agroforestry

in these degraded areas as well as an evaluation of economic incentives and policy options to motivate the adoption of afforestation at the farm and regional scale. The combined findings facilitate spatial targeting and provide policy advice on introduction of forestry among farm activities for the landscape rehabilitation and improving rural resilience to the changing agroecological environment.

Conserving rural landscapes by new corporates connecting farm households and urban hobby farmers in Japanese cities

Makoto Yokohari, Department of Urban Engineering, The University of Tokyo

Unlike European and North American countries, Japanese agricultural policies have initially been designed by identifying farm households, not farmland. As a consequence Japanese cities commonly accommodate fragmented farmland patches owned and maintained by farm households, which are controlled by agricultural policies. Farmlands in urban areas may provide ecological services when they are properly managed. However, the number of farm households is sharply decreasing and urban farmlands are becoming to be abandoned. Increasing the number of people cultivating lands is the key to restore Japanese agriculture and thus to conserve livable cities. Instead of declining agriculture, entrepreneur businesses aiming to deliver farming experiences to urbanites are now mushrooming in Japan. To identify their characters and potentials we conducted an empirical study, which included interviews and questionnaire surveys to organizers and users. The study identified that such new businesses not only provide hobby gardens to urban farmers but function as a training center for urbanites who wish to become professional farmers. Japanese agriculture should illustrate its future by taking an alternative pathway which tries to invite urban hobby farmers as its indispensable successors. The future of agriculture in Japanese cities is in the hands of entrepreneur agricultural businesses.

Spatial patterns of forest values for bioenergy production in the Western Upper Peninsula of Michigan

Audrey L Mayer, Michigan Technological University*

The transition from fossil to renewable energy presents significant environmental, economic, social and technological challenges. Ecological impacts of bioenergy feedstock production in rural landscapes have been well defined (if still preliminary). However, the socioeconomic impacts have received less attention, particularly as experienced by communities in these landscapes. In this study, participatory mapping was used to identify these impacts in landscapes of the Upper Peninsula of Michigan. In focus groups and interviews, stakeholders identified key areas where feedstock production might enhance or deplete socioeconomic values. Stakeholders represented state and local government officials (state agencies, township supervisors, school districts), representatives of firms in the forestry and energy industries (with local to international operations), Tribal members, and private landowners. Multiple stakeholders specifically identified abandoned agricultural areas in Ontonagon County as an area where feedstock production might enhance social, economic and environmental values. Private landowners were generally supportive of feedstock production on their or local properties, but were not willing to reforest cleared areas with tree feedstocks (switchgrass was preferred), and most stakeholders did not want mature, natural forests to be harvested for bioenergy. This process not only identified sustainability criteria that were important to local communities for renewable energy production, but also areas of the region where this activity could take place that would minimize conflict with other values.

Assessing coupled landscape vulnerability and resilience from rapid urbanization to inform coastal urban planning

Yangfan Li,Xiamen University*

Integrated Coastal Zone Management (ICZM) requires assessment approaches at landscape scale for understanding the influence of rapid urbanization on coastal environments and ecosystems. Here we introduce a model for assessing the coupled vulnerability and resilience to coastal wetlands from multiple coastal uses. We apply the model to mangrove wetlands in China to inform the design of the local urban planning, regional development and ICZM Plan. This study improves the framework of "exposure- sensitivity-resilience" for vulnerability analysis and addresses the resilience with the theory of adaptive cycle which involves the movement of a system through four phases (exploitation-r, conservation-K, release-Î© and reorganization-Î±). We then develop an evaluation framework for regional environmental vulnerability, resilience and early warning system of coastal urbanizing areas using spatial analysis. This methodology is being developed for application in a variety of coastal urban contexts around the world.

Introdcution to Morning Section

David J. Mladenoff; Jodi A. Forrester; Matthew Noone, Dept of Forest & Wildlife Ecology, University of Wisconsin-Madison.*

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Networks in Landscape Genetics

Melanie Murphy, University of Wyoming

Landscape genetic are naturally graph-like in structure. Graph analyses have huge potential to address landscape genetics questions. I will introduce graph approaches, using graph metrics, and applications to landscape genetics questions. Graphs can be used to describe genetic structure, test a priori hypotheses of structure and in inferential models with independent parameters. I will present brief case studies of these multiple approaches including the use of independent parameters at samples sites (nodes) and between sample sites (edges). I will conclude with current research needs is using graph approaches in landscape genetics.

A LANDIS-II module for integrating land use and other disturbances

Jonathan R. Thompson, Harvard Forest Harvard University; James Domingo, Center for Research Computing at University of Notre Dame; Erin Simons-Legaard, School of Forest Resources University of Maine Kasey Legaard, School of Forest Resources University of*

Forest landscape models (FLM) are often used to examine the influence of disturbance processes on long-term and broad-scale forest ecosystem dynamics. However, FLMs are not well-suited to simulating the spatial dynamics of some types of disturbances, including land-use change. Moreover, there are many circumstances wherein a researcher may wish to dictate the precise timing and location of disturbance events. We present a module for the widely-used LANDIS-II FLM that allows users to incorporate spatially and temporally explicit representations of land-use or land cover change, developed externally, into LANDIS-II simulations. This module includes several components, which allow users to model the proximate effects of land-use change on forest biomass, as well as subsequent forest dynamics, including tree establishment and the potential for future disturbances on the altered sites. Designed to be flexible, this module can also be used to model the effects of specific disturbance events (e.g., hurricane) on forest conditions. This module will significantly increase the breadth of research questions for which LANDIS-II may be appropriately employed.

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Analysing ecosystem service trade-offs by combined global-scale land change and ecosystem modelling

Rene Sachse, University of Potsdam & PIK Potsdam; Kirsten Thonicke, PIK Potsdam; Peter Verburg, VU University Amsterdam; Ariane Walz, University of Potsdam & PIK Potsdam*

Land use transition and climate change will be the main reasons for changing provision in ecosystem services worldwide over the coming decades. Both processes impact human-environment systems from local to global scale. The global scale analysis will be able to provide estimates for supply of selected ecosystem services across major managed and unmanaged ecosystems and will reveal effects of competing policy directions, namely the Convention of Biodiversity and Climate Mitigation Policy, and the need to feed an increasing global population. To better understand the impacts of main land pressures on ecosystem services under alternative global development pathways we use the dynamic global ecosystem model LPJmL, and simulate future states of managed as well as unmanaged ecosystems under climate change. These ecosystem simulations were driven by global-scale simulations of land-use change (CLUMondo) until 2040, and depict effects of biodiversity conservation and climate protection, and the combination of both, under increasing demand for food. The combined simulation results of vegetation and land-use change allow us to present major trade-offs and synergies in ecosystem service supply for major biomes. Furthermore, they support the evaluation of synergistic policy options between conservation and climate change mitigation scenarios and provide a common basis to discuss the often competing policy domains of nature conservation and climate protection.

A range-wide climate vulnerability assessment of yellow-cedar along a 20 degree latitudinal span of the Pacific Coast temperate rainforest

Paul Hennon, USFS; Stefan Zeglen, BC Min of For; Joel Trubilowisz, UBC; Sari Saunders, BC Min of For; Bill Floyd, BC Min of For; Connie Harrington, USFS; Dave D'Amore, USFS; Brian Buma, UAS; Allison Bidlack, UAS

There is growing awareness that climate vulnerability assessments and associated adaptation strategies for sensitive species require broad geographic perspectives that span land ownership, international boundaries, and climate zones. Our transboundary Canada-US team evaluated the occurrence, areas of intense mortality, and predicted future health of the valuable yellow-cedar tree across its entire range from the Siskyou Mts in northern California to Prince William Sound in Alaska. We developed a new seamless high resolution range-wide distribution GIS layer for yellow-cedar by stitching together literature reports, regional species distribution models, cover type maps, and in small isolated populations, our own observations and surveys. We merged spatial information on the extent of the widespread mortality ("yellow-cedar decline") which covers more than 200,000 ha in Alaska and 100,000 ha in British Columbia in a 1,000 km north-to-south band. Then, we examined how the spatial pattern of both yellow-cedar and existing mortality varied by elevation across the nearly 20 degrees of latitude of the species' range. Finally, a new snow model was developed to predict snowpack in February and March, a season when yellow-cedar is most vulnerable to freezing injury in the absence of snow. The snow model was compared to the spatial distribution of existing yellow-cedar decline to determine the threshold of snow needed to protect yellow-cedar from injury. A composite of six general circulation models was used to predict future snowpack and the resulting expected spread of yellow-cedar decline to currently healthy populations through the end of the century.

How to assess urban development potential in mountainous areas? An approach of ecological carrying capacity in the view of coupled human and natural systems

Yueyue Du, Jian Peng* College of Urban and Environmental Sciences, Peking University, The Key Laboratory for Earth Surface Processes, Ministry of Education, 100871 Beijing, China*

Ecological carrying capacity (ECC) is the key to measuring sustainable development of regional society, economy and ecology. However, the former evaluation indicators focused on characterizing the carrying capacity of the natural ecosystem, unable to clearly reveal its feedback to and interaction with humans. And previous studies mainly concerned capacity threshold of a single area while ignored interregional comparison of capacity potential. Taking Dali Bai Autonomous Prefecture in Yunnan Province, China, as a study area, this paper explored the conceptual framework for ECC in the view of coupled human and natural systems (CHANS), and then constructed an index system using aspects of ecosystem vigor (EV), resources and environmental carrying capacity (RECC), and social development ability (SDA). The assessment results at county level showed that (1) the high EV appeared in counties with relatively good ecological background and stable geological environment such as Dali City, the high RECC appeared in those with abundant stock of water and land resources like Yunlong County, and SDA was better in areas with more concentrated population and more flourishing urbanization; (2) by hotspots identification based on spatial combination of individual ECCs, the study area was grouped into five categories i.e., areas prior to conservation, areas prior to development, areas suitable for short-term conservation but long-term development, areas suitable for short-term development but long-term conversation, and areas reserved for flexible developing. This research will effectively evaluate resilient developing space in short-term and long-term using ECC with CHANS approach, and serve for mountainous area development and construction.

Collaborative learning for coastal watershed planning in Douglas County, Wisconsin: A qualitative analysis of stakeholder experiences

Katy Thostenson, University of Wisconsin-Madison, Nelson Institute for Environmental Studies; Janet Silbernagel, University of Wisconsin-Madison, Nelson Institute for Environmental Studies*

As a result of historical land use changes and the loss of coastal wetlands, the volume and velocity of water flow in the Lake Superior Basin has increased, threatening the resiliency of coastal communities in northern Wisconsin. To address this socio-ecological challenge, the Lake Superior Watershed Framework for Assessment of Wetland Services (a National Estuarine Research Reserve System Science Collaborative project) applied an integrated approach, bringing together local stakeholders and scientists to develop a process for watershed planning at the local level. Using collaborative learning techniques, the project engaged stakeholders to identify areas for wetland conservation that meet watershed needs, fulfill compensatory wetland mitigation requirements, and honor community values. An interview study was conducted with sixteen local stakeholders who served on the project, gathering their perspectives on the collaborative learning process and its effectiveness toward achieving shared goals. Findings indicate that the project's structure and methodical process created an inclusive learning environment which decreased the emotional level of discussions, improved dialogue and understanding of other stakeholders' motivations and concerns, and allowed for greater trust and transparency between parties. Though optimistic, stakeholders felt political and economic barriers and a lack of broader community support for the project could hinder shared goals. This study demonstrates that the perspectives of stakeholder partners are vital to identify actions appropriate to the cultural, political and economic context, and thereby to achieve shared goals. Practitioners working with communities can benefit from a collaborative learning process to develop a locally-supported, science-based approach to coastal land use planning.

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Indicators for a nationwide assessment of ecosystem services as contribution to the EU biodiversity strategy 2020

Syrbe, Ralf-Uwe; Walz, Ulrich; Grunewald, Karsten; Meinel, Gotthard; Herold, Hendrik (IOER Dresden); Marzelli, Stefan (ifuplan Munchen); Schweppe-Kraft, Burkhard (BfN Bonn)

Action 5 of the EU Biodiversity Strategy demands a nation-wide assessment of ecosystem services for all member countries by 2020 (aim 2). In order to fulfill this task, Germany is developing an indicator set for selected ecosystem services comprising supply and demand indicators for several categories. A selection of indicators for provisioning, regulating and cultural ecosystem services are currently under processing. We discuss the selection process and show assessment results. The indicators should represent the quality of ecosystems as well as their values and services. The preservation of biodiversity is the underlying motivation for the assessment and mapping, which relates also to land use diversity, landscape structure and ecological connectivity. Indicators are selected and calculated in a way that allows regular replication using nation-wide public data. Thus, the method enables also to monitor the ecosystem service (ES) and to highlight their changes. The mapping of ES indicators is first done for test areas and is then enlarged to the entire federal territory of Germany. First results will be shown for the wood, food and water provision, the regulation of CO2, floods and water quality.

People in Ecosystems/Watershed Integration (PEWI): A dynamic land-use and ecosystem service tradeoffs assessment tool

Carrie M. Chennault, Lisa A. Schulte, John C. Tyndall, John K. Van Dyk, Ryan Frahm -Iowa State University*

People in Ecosystems/Watershed Integration, or PEWI, is an educational web application designed to enhance user understanding of land-use and ecosystem service tradeoffs in agricultural watersheds. PEWI is an open-source online tool with a simple approach: users design and evaluate patterns of land use on a virtual US Corn Belt watershed across multiple years and variable weather conditions. PEWI illustrates agronomic, water, carbon, and biodiversity management principles important for sustainable land use and land management. The tool also facilitates teaching complex principles key to human livelihoods, including resilience and adaptation during periods of climate and political-economic uncertainty. PEWI differs from other models that simulate the complex tradeoffs associated with land use in that it does not require guidance from expert modelers. The tool provides instant feedback to any user, reveals both relative and absolute tradeoffs among ecosystem services, and does not require user-supplied data. To demonstrate how tradeoffs are represented in PEWI, we present three alternative watershed scenarios designed to meet water quality goals established by the Iowa Nutrient Reduction Strategy and compare them to a baseline watershed scenario of 100% conventional crop production. All three alternative scenarios meet water quality objectives but differ in the amount of land taken out of crop production and the production of ecosystem service co-benefits, such as habitat for biodiversity and carbon sequestration. Furthermore, the designs are more or less effective depending on simulated annual weather conditions. More information on PEWI can be found at www.nrem.iastate.edu/pewi.

Optimising the sampling design of landscape genetic analyses using resistance surfaces

Bernd Gruber, Institute for Applied Ecology, University of Canberra; Aaron Adamack, Institute for Applied Ecology, University of Canberra*

To be able to predict the spatial dynamics of species, knowledge on the ability and frequency of individual dispersal events are a fundamental requirement. Recent advances in genetic techniques have enabled ecologists to estimate the effect of landscape features such as roads, rivers and unsuitable

habitat on dispersal. Least-cost path analysis is the most commonly used approach to study the effect of landscape features on dispersal. The basic idea is simple - various landscape models represented by distance matrices that incorporate the effect of landscape features on dispersal are compared to genetic distance matrices. Though this is potentially a very powerful approach, we demonstrate that the effect of the geometry of the sampling design is of prominent importance and critical on the success of a study. We simulated different geometries of sampling designs and demonstrate, though all other parameters of a study are held constant (sampling effort, number of genetic markers and population sizes), that the approach can be successful or fail to identify potential barriers purely due to the geometry of the sampling design. We present an approach that allows us to predict the likely performance of an intended study design by simply studying the geometric properties of the sampling design. Using our approach the sampling design of an intended study can be optimised, which leads to more precise estimates of the effect of landscape features on population dynamics and therefore to a better ability to study spatial population dynamics of species.

SYM: Increasing beneficial insect and native pollinators on farms through farmscaping and remote sensing for ecological service quantification. Building a regional network for linking science, policy

Symposium Moderator:Stephen K. Ndzeidze, IPPC - Oregon State University, Corvallis Session Presenter: Gwendolyn Ellen, IPPC - Oregon State University, Corvallis

Abstract: Farming systems replace native habitats, but they rely upon access to the ecological services provided by native ecosystems notably pollination and pest suppression. Evidence suggests that increasing functional biodiversity in farming systems can enhance these ecosystem services. However, a number of challenges including lack of regionally specific applied research and technological assistance, paired with monetary and regulatory disincentives hinder widespread biodiversity improvements. Because adopting agricultural biodiverse practices is so place, farming system and ecosystem based, effectively addressing these challenges requires a coordinated effort among farmers, researchers, conservationists, and policy makers. Supporting local leaders who have adopted or have aided farmers in adopting such practices is pivotal to moving a local agricultural biodiversity conservation program forward. A regional coordinated approach to promoting agricultural biodiversity is the Functional Agricultural Biodiversity Work Group (FABWG). The FABWG is a collaborative forum for practitioners such as farmers and conservationists, applied researchers, and policy experts from both government and non-governmental organizations. Its goal is to foster regionally specific research and outreach, better communication among stakeholders and improved policy driven incentives to enhance the biodiversity of Western agricultural ecosystems. The group uses a participatory and active learning approach that involves all stake holders in the decision and planning process. A key tool for building this network has been a series of advocacy tours held annually since 2007 on biodiverse farms in OR, WA, CA and ID. Participants included over 250 practitioners, agricultural support personnel policymakers and regulators. The FABWG members use the information gained from the short courses to develop collaborative research projects that have totaled over a half million dollars in awards. These successes suggest that the FABWG provides a good model for building a regional knowledge network that can effectively integrate science, policy, and on the ground, local implementation of biodiversity.

Development of a new standalone model toolset (FORE-SCE) to support assessments of the impacts of climate and land-use/land-cover change on ecological processes

Jordan Dornbierer, SGT; Terry Sohl, USGS; Kristi Sayler, USGS; Ryan Reker, Inuteq; Steve Wika, SGT; Rob Quenzer, SGT*

Scientists, planners, and decision makers exploring potential changes in ecological processes require spatially explicit land-use projections that account for the impacts of climate, including precipitation variability and resulting droughts. Land-cover modelers at USGS EROS have created future and historical land-cover simulations for regional and national applications. While these projections are valuable for a variety of purposes, there are a multitude of analysis requirements that would benefit from the availability of climate-sensitive land-use projections tailored to meet project-specific needs. In addition to creating future/historical LULC projections, USGS EROS is developing a standalone and publicly-available LULC forecasting model, FORE-SCE (FOREcasting SCEnarios of land-use change), that will enable stakeholders to quickly create custom, climate-sensitive, scenario-based landscape projections to satisfy unique application requirements. The FORE-SCE suite of tools is being built with an open source framework in mind. The distributable toolset is being written in Python-leveraging the Python community's rich array of science and data analysis packages-and will be executable through a variety of options, ranging from commercial and open source GIS software add-ins to command line. Development of the toolset will be completed in a collaborative environment utilizing feedback from a diverse cross section of the intended user community to ensure the tools meet usability and flexibility requirements. This presentation will highlight the applications of FORE-SCE for a variety of landscape analysis needs and update progress on the development of a distributable toolset.

More housing units and less people around protected areas in Puerto Rico?

Jessica Castro, Department of Environmental Sciences, University of Puerto Rico; Maya Quiniones and William Gould - International Institute of Tropical Forestry, U.S. Forest Service USDA*

Land cover change from natural to urban cover in lands adjacent to protected areas has become one of the emerging and fast growing threats to protected areas worldwide, and the most important threat to protected areas in developed countries. These threats increase in intensity the closer they get to protected areas. Our goal was to measure urban and population change in lands adjacent to protected areas in Puerto Rico. To accomplish this goal we generated a dasymetric map for the island using a modified version of the land cover 2000 in which we also included protected lands as ancillary data. This analysis was conducted for census blocks for the census years 2000 and 2010. Finally, we used the dasymetric map to quantify population and housing change between both census years and at different distances outward from protected areas' boundaries. Preliminary results suggest that even though human population has been decreasing in Puerto Rico, new houses have been constructed in the island. However, the observed urban growth closer to protected areas in Puerto Rico responds to a process of suburbanization, rather than a process of counter urbanization as observed in the United States and other developed countries.

Strengthening the links between climate and succession in forest landscape models

Eric J. Gustafson, USDA Forest Service, Northern Research Station; Arjan M.G. De Bruijn, Purdue University; Brian R. Sturtevant, USDA Forest Service, Northern Research Station*

Global changes have the potential to render obsolete many of the empirically-derived relationships used to predict forest dynamics. To make landscape models more robust to novel environmental conditions, the processes simulated by them must increasingly be directly linked to the fundamental environmental drivers that are changing. In many cases this will require development of more mechanistic components. We incorporated tree physiology "first principles" into the PnET-Succession extension of the LANDIS-II forest landscape model to simulate tree growth as a competition for light and water as a function of climate and CO2 variables. Because LANDIS-II consists of multiple process-based succession and disturbance modules acting independently on the ecosystem "currency" of species cohort biomass, their

interactions become an emergent property. This allows robust simulation of climate change effects on forest dynamics at landscape spatial and temporal scales. We illustrate the power of this approach with 1) a test of the ability of the model to predict the outcome of a precipitation manipulation experiment in a pinyon-juniper ecosystem in New Mexico and 2) a virtual climate change experiment in a sub-boreal ecosystem in Wisconsin.

Spatial heterogeneity and structural development pathways following fire in western larch/mixed-conifer forest

Andrew J. Larson, Department of Forest Management, University of Montana, Missoula, MT, USA; and R. Travis Belote, The Wilderness Society, Bozeman, MT, USA

Since the 1980s managers have allowed many lightning-ignited fires to burn with minimal interference in forests of the Bob Marshall Wilderness (BMW) in northwestern Montana, USA. We used this contemporary active fire regime to investigate fire-effects and post-fire structural development in western larch (Larix occidentalis)/mixed-conifer forest. Our study system comprises mixed-conifer forest in the South Fork Flathead River valley within the BMW. We reconstructed pre-fire live tree populations and mapped all dead trees â‰¥20 cm dbh and all live trees â‰¥5 cm dbh within two, 4.41 ha (210 m x 210 m) study areas, both of which burned in 2003. We sampled coarse woody debris (CWD) and tree regeneration within 49 contiguous 900 m2 quadrats (30 m x 30 m) superimposed on our mapped study area. We identified four post-fire tree regeneration groups at the 900 m2 quadrat scale that span a gradient from low densities of slow-growing, shade-tolerant tree regeneration (RG1), to extremely high densities of very fast-growing, shade-intolerant species (RG4). The RGs were associated with different fire severities and residual live tree size structures at the 900 m2 quadrat scale. Percent mortality of trees â‰¥20 cm dbh increased, and density of live trees â‰¥5 cm dbh decreased from RG1 to RG4, but volume of CWD did not vary across RGs. The RGs and their associated residual stand structures assemble into four distinct post-fire structural development pathways, revealing some of the successional mechanisms through which fires generate and maintain structural complexity and spatial heterogeneity in mixed-conifer forests.

Are landscapes more than the sum of their patches?

Kimberly A. With, Division of Biology, Kansas State University

The species-area relationship (SAR) is perhaps the most ubiquitous scaling relationship in ecology, and yet, we still do not know how different aspects of scale affect its estimation and interpretation. Scale is defined by grain and extent, but also, by focus. Focus is the scale at which the data are pooled prior to analysis, which in this study, pertains to whether individual patches or entire landscapes that vary in habitat area are the basis for deriving SARs. Using arthropod-richness data from an experimental model landscape system, in which habitat area and fragmentation (of red clover) were adjusted independently in small (16 x 16 m) plots, I explore whether altering the focal scale from patch area to habitat area influences the resulting SAR. Importantly, both grain and extent were kept constant. Scale invariance predicts congruence between patch-based and landscape-based analyses of species-area effects; in that case, landscape richness is simply the sum total of patch richness. If landscape structure (fragmentation) influences the scaling of species richness, however, then the SAR is scale-dependent and different processes likely influence patterns of species richness at different focal scales (patch vs. landscape) that goes beyond just how species turnover ($\hat{I}^2$-diversity) contributes to total richness.

Monitoring the canary of the sagebrush biome: adapting regional land cover minimums to a management framework for greater sage-grouse.

*Theresa Burcsu, Institute for Natural Resources, Portland State University**

Greater sage-grouse (Centrocercus urophasianus) is a large, charismatic, sagebrush-obligate bird that inhabits semi-arid shrub-grassland (shrub steppe) habitats of western North America and currently occupies just over half of its historic range. Much of its habitat has been lost, degraded, and fragmented due to human activities, invasive plant species, and changes in ecosystem regimes. The close relationships of the bird to its habitat, its habitat to landscape dynamics, and the vastness of the speciesâ€™ range present considerable obstacles to successful habitat monitoring and management. These obstacles are magnified by variation in ownership, management, and political boundaries throughout its range. To help address ecological and institutional complexities at the state level, we sought to understand the scaling properties of habitat conditions captured as land cover types sampled at scales ranging from mating and nesting grounds (leks) to federal agency districts. Our results indicate that local-scale minimum land cover requirements appear to scale to broader habitat units likely to be used for monitoring and management and can therefore be used to guide adaptive management decisions in terms of conserving existing, utilized habitat. However, differences in the proportions of key land cover types in close proximity to historic mating sites suggest that local drivers of lek extinction may differ from regional drivers.

Remote Sensing and Spatial Indicators for Detecting Urban Trajectories

Maik Netzband, Ruhr-University Bochum, Germany

Satellite data and further geo-information data are used for landscape ecological evaluations, e.g. to predict structural diversity in landscape, to derive quantitative data on open space fragmentation and on interlink of biotope structures. Satellite images are just as much used to identify compensational areas for planning of building land in conurbations or to quantify landscape metrics by means of derived medium and high resolution satellite parameters in order to calculate neighbourhood relations of objects. Within the last two decades landscape structure indices or metrics have been implemented on remote sensing image data for different mapping scales. Nature, in particular in the suburban cultural landscape is described regarding indicators such as structure (line or planar expansion, cutting, island areas, etc.), dynamics (entry of the modification processes) and texture (neighbourhood relations to other land use forms). This is based on the identification and computation of static and dynamic indicators that help providing a synthetic assessment of suburban landscapes. The indicators will also allow the comparison of the environment's condition in different conurbations. A methodological approach is presented applied to different parts of Europe in growing as well as shrinking urban regions, after which monitoring and evaluation of a landscape diversity in suburban landscapes are feasible on the basis of medium and high resolution satellite data.

Solitary trees as reservoirs of spatial, but not temporal beta diversity in a savanna landscape

Elise Tulloss, Department of Plant Sciences, University of California, Davis; Mary Cadenasso, Department of Plant Sciences, University of California, Davis*

Savannas are a globally-distributed biome and are often biodiversity hotspots. Diversity in savannas may be strongly influenced by the vegetation structure, which creates a micro-environmental gradient between the relatively mesic understory of isolated savanna trees and open grassland. We examined plant species and functional trait diversity in a savanna landscape to investigate how isolated savanna trees affect biodiversity. We established plots in the understory and adjacent open grassland at a site in northern California in 2010. For two years species relative abundance was measured in each plot along with soil moisture and nutrient content. We partitioned species and functional trait diversity into its

alpha, beta, and gamma components and analyzed how location in the understory versus the open grassland influenced diversity. We performed a nonmetric multidimensional scaling analysis to further investigate community composition across the landscape. In nearly all analyses, location on the landscape was a significant predictor of plant diversity. In particular, beta diversity was higher in understory locations, indicating greater species turnover from tree to tree across the landscape compared to the open. There was a significant year effect in which species were more stable between the two sample years in the understory compared to the open. The onset of an extreme drought in the second year of the experiment may explain this pattern, with the understory acting as a microclimatic refugium. Savanna trees represent an important contribution to the diversity and stability of the regional plant community, particularly as droughts become more severe under climate change.

Biodiversity and Ecosystem Services in the Los Angeles, USA Metropolitan Region

Darrel Jenerette, University of California Riverside

In meeting the needs of rapidly expanding city residents, ecosystem functioning within the urban boundary may provide several key services ranging from life-sustaining services such as climate regulation and food production to services associated with recreation and aesthetics. In contrast, ecosystem disservices are associated with ecosystem characteristics that have a negative impact on residents and range from potentially injurious components such as increasing pollutant exposure or additional resource requirements such as irrigation water. Identifying trade-offs in both services and disservices is a priority for assessing how ecosystem functioning influences urban residents. Here I highlight recent findings associated with urban ecosystem services associated with variation in urban forests and urban gardens as two contrasting ecosystem types within Los Angeles, CA metropolitan region. These research efforts are leading to improved understanding of the variation in the production of and specific desires for ecosystem services and disservices. Initial data across several studies suggests desires for services show sensitivity to both socioeconomic status as suggested by a hierarchy of needs hypothesis and local environmental conditions as suggested by an environmental determinism hypothesis. Consequently, the production of ecosystem services also varies dramatically across socioeconomic and climate gradients. Future projections of the rates of service production are highly uncertain with likely strong nonlinearities in responses to urban conditions. Designing for sustainable ecosystem services within cities such that benefits are maximized and costs are minimized as we prepare for a near future with 2.5 billion more urban residents.

Corporate Ecosystem Services Strategies in Brazil: Opportunities and Challenges

Suzanne Ozment, World Resources Institute

Since 2011, the Business Ecosystem Services Partnership in Brazil (led by Brazilian Business Council for Sustainable Development and the World Resources Institute) has worked with companies to develop proactive strategies that respond to ecosystem change. By applying the World Resources Institute's Corporate Ecosystem Service Review (ESR) method, participating companies have assessed business risks and opportunities arising from their dependence and impacts on ecosystem services. These assessments have inspired some participating companies to develop strategies that align ecosystem stewardship with corporate performance. This presentation reviews the successes and challenges facing the partnership by highlighting Danone-Brazil's ESR experience and results. Danone assessed ecosystem services at a manufacturing plant, in its strawberry supply chain, and in its milk supply chain in Brazil. The company then developed an ambitious management strategy to cost-effectively protect ecosystem services it relies upon. This presentation will support a dialogue on the business case for ecosystem

stewardship, the role of business in addressing ecosystem change, and the feasibility of supply chain and landscape-level ecosystem stewardship collaborations.

A new method for estimating atmospheric trace gas fluxes at high resolution

David Baker, CIRA/Colorado State University

The measurement of trace gases in the atmosphere can help refine the processes described in land ecosystem models, particularly those carbon cycle processes of interest for predicting future climate change. Satellite measurements of CO2, CO, and CH4, among others, can provide a global, fine-scale constraint that integrates the effects of such processes as photosynthesis, respiration, and fire. New measurements of near-IR spectra from sunlight reflected from the surface enable sensitivity down to the surface, opening the possibility of estimating surface fluxes at fine spatial scales from these data. The sheer volume of this data, as coverage expands from sampling missions (a dozen ground tracks per day) to mapping missions (repeat scans of the continents per day on a grid of several km resolution) in the coming years, poses a computational challenge: how can we solve for surface fluxes at fine spatial scales (from 1 to 20 km, say) when it is extremely time-consuming to run the atmospheric transport models needed to do the inversion problem at these resolutions? Here we parallelize the variational approach typically used by applying Bennett's representer method, enabling fine-resolution estimates from dense satellite data. The measurements are discretized into blocks in space and time, with basis function being run through the transport model (in parallel) for each block. Fluxes are estimated in a single matrix inversion in measurement space, the state and covariance from which may then be used to precondition a traditional variational search, either in the model or measurement space.

Sustainable energy potential from biomass through Ecosystem Service Trade-off Analysis: the case of the Province of Rovigo (Veneto Region, Italy)

Elena Gissi, University Iuav of Venice; Mattias Gaglio, University of Ferrara; Matelda Reho, University Iuav of Venice*

Bioenergy production is an important Ecosystem Service (ES) provided by natural and semi-natural ecosystems which can concur to reach European Union climate and energy targets for 2020, as well as energy security and contributes to a local economies development. Their environmental and social impacts are widely discussed and often result in severe conflicts between energy producers and local communities. However, cumulative impacts from feedstock supply chain at territorial level, as well competing anthropogenic uses on landscape resources and related ES, are often ignored or underestimated in energy planning and in plants permits issuing. This study applies an ESs based approach in order to quantify and map a bioenergy sustainable potential in the Province of Rovigo (Veneto Region, Italy), an intensive exploited agro-environment, and translating bioenergy environmental impacts in terms of ESs trade-offs. Theoretical potential, based on land cover map, has been calculated for different feedstock chains according to the specific characteristics of the study area, and then confronted with other ecosystem services as food production, carbon storage, landscape cultural values and supporting biodiversity. The results show that the portion of bioenergy feedstock out of trade-off with other ecosystems services is limited. Management solutions should be considered in order to mitigate trade-offs with other ESs, increasing ecological and social acceptability. This study highlights that ESs approach can provide a suitable tool for decision makers, through a holistic view which harmonize natural resources and social needs and provides an innovative and sustainable management of renewable resources.

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Exploring the social production of Ecosystem Services within a decision making process. Comparative analysis from a role-playing game approach in South East Europe.

Vito Garramone, University Iuav of Venice; Elena Gissi, University Iuav of Venice*

Ecosystem Services has gained relevance in supporting decision making process towards sustainability. Within the well-known ES cascade model (Haines-Young and Potschin, 2009) ecosystems processes and structures give place to ecosystem functions, which are interpreted as ecosystem services because of their benefits and values for society. In the interplay between demand and supply, ES are those functions which are recognized by the end users, as decision makers, local communities and economic actors, in a process of knowledge building, knowledge exchange and negotiation, as to activate social and natural capital simultaneously. However, while the capacity to supply ES is strongly investigated, the process and dynamics of recognition and activation of functions as services, benefits and perceived values has been less considered. The present contribution aims at exploring social production of ES, as the process of knowledge activation and selection of ecological functions by the actors contributing in decision making processes. The analysis is drawn from a comparative experimental approach, applying a Role Playing Game (RPG) on trade-off between ES within a stakeholder participation process to support sustainable development through Renewable Energy Sources (RES). The experiment has been replicated in 10 sessions in 8 Southern East European Countries, with almost 230 participants from marginal rural landscapes. Qualitative and quantitative results are discussed within the framework of social learning, in relation to the problem setting, to the process of knowledge building, as well as to the solutions which emerged from the interpretation of the same problem by different pools of stakeholders.

Using multi-temporal Landsat imagery for rapid identification of abandoned agricultural land in areas affected by urban sprawl

Simona R. GrÄfdinaru, Swiss Federal Research Institute of Forest, Snow and Landscape - WSL / Centre for Environmental Research and Impact Studies - University of Bucharest; Anna M. Hersperger, Swiss Federal Research Institute of Forest, Snow and Landscap*

In former socialist countries, urban sprawl and agricultural land abandonment are significantly affecting provisioning and regulating services. Earlier studies showed that these two processes are highly interlinked and that abandoned land can be used as a significant predictor of urbanization dynamics at the periphery of sprawling cities. However, these studies involved extensive field mapping and orthophotomaps interpretation which can be time consuming and expensive. In this study we evaluated remote sensing as alternative tools for rapid assessment of land cover. We used Landsat 8 data due its high temporal and spatial resolution and its wide and free availability. Due to the rapid land use changes in the last decade, we selected the city of Bucharest and the surrounding agricultural lands as our study area. The Normalised Difference Vegetation Index (NDVI) was calculated over the growing season to establish unique temporal NDVI signatures of abandoned lands and areas of other land use types (forest, crops, water, etc). Then classification models were trained and validated using orthophotomaps and topographic maps. We conclude that the use of Landsat imagery is an efficient method for identifying the spatio-temporal dynamics of abandoned land at short time intervals (1-2 yrs). Due to its predictive ability remote sensing data can be used to identify future hotspots of urbanization. Moreover, abandoned land serves as an important indicator to anticipate and eventually control sprawl pattern in fast growing cities in transition countries.

The Swiss landscape monitoring program: bridging the gap between bio-physical space and perceived place

Felix Kienast, Swiss Federal Research Institute WSL

Many landscape monitorings are limited to the physical and biological space, despite the fact that land-use is strongly linked to the socio-cultural realm via people's perception. The latter is an important component for quality of life and people's place attachment. The Swiss Landscape Monitoring Program LABES (abbreviation for German Landschaftsbeobachtung Schweiz) is one of the first large-scale landscape observatories (total area ca. 40000 km2) where landscape perception is systematically monitored with representative surveys. The entire monitoring consists of roughly 30 indicators that are embedded in the DPSIR framework (i.e. Driving force Pressure State Impact and Response). Approximately 25% of the indicators measure perception properties. Respondents are instructed to base their statements on the landscape and places of their current home municipality rather than on pictures of specific landscapes. We distinguish two perception concepts: (1) an evolutionary determined perception component (concepts of Kaplan & Kaplan) and (2) a culturally determined component based on concepts such as e.g. fascination, landscape beauty or authenticity. Innovative indicators of the physical space are light emissions which is a straight-forward surrogate for urbanization and human activities. We also measure fragmentation and urban permeation as well as areas without buildings and infrastructure and close-by recreation areas. At the moment ca. 50% of the indicators are available as time series. A rigid quality control with advanced statistical methods showed that the indicators are geographically representative for Switzerland. A core set of indispensable indicators was determined and links between the physical and the perceived space elaborated.

Defining Desired Conditions for Restoration of Fire-Prone Forest Landscapes: Lessons from the Collaborative Forest Landscape Restoration Program

Lauren Urgenson, School of Environmental and Forest Sciences, University of Washington; Charles Halpern, School of Environmental and Forest Sciences, University of Washington; Ernesto Alvarado, School of Environmental and Forest Sciences, University of W*

Restoration of frequent- and mixed-fire regime forest landscapes is a pressing natural resource issue throughout the western U.S. However, management of these landscapes is complex due to a challenging regulatory environment and differing objectives and values of stakeholders. In 2010, the USDA Forest Service created the Collaborative Forest Landscape Restoration Program (CFLRP) to implement collaborative, science-based restoration of priority landscapes. A central role of the collaborative process is to develop a shared vision for 'desired conditions' that serve as a foundation for restoration approaches and monitoring strategies. Desired conditions include ecological, social, and economic objectives for restoration and the stand and landscape structures likely to support these objectives. Moreover, desired conditions are not static but encompass significant variation in space and time. We use a comparative case-study analysis of six CFLRP collaboratives in the western U.S. to examine how groups face the challenges and find solutions to identifying desired conditions in landscape-scale restoration. Despite strong local differences in social and ecological context, groups face many similar challenges, including uncertainty in the use of historic reference conditions; dissonant stakeholder perspectives on scientific data and values; lack of a clear process for involving the collaborative at the Forest Service's pre-planning levels; and moving from broad agreement on desired conditions to an understanding of the types of stand structures and treatments that will achieve those conditions. There is a clear and urgent need to synthesize and share lessons learned among land managers, scientists and policy decision-makers to benefit ongoing and future restoration.

Underwater soundscape, habitat characteristics and fish activity in a shallow lake during winter

Irene Torrecilla Roca; Universite du Quebec Ã Trois-RiviÃ¨res Pierre Magnan; Universite du Quebec Ã Trois-RiviÃ¨res RaphaÃ«l Proulx; Universite du Quebec Ã Trois-RiviÃ¨res

Underwater ambient sounds convey habitat information to moving organisms as well as remote observers. Understanding the structure of fish communities under the ice sheet in winter is particularly challenging and underwater acoustics has shown promise for characterizing these habitats. In our study, we examine the relationship between underwater ambient sounds, physical and chemical water characteristics and fish activity in a shallow fluvial lake during winter months. Over two consecutive years, we conducted repeated surveys of underwater habitats and fish communities using tip-up fishing rods. We fitted generalized mixed models to disentangle the roles of both underwater acoustics and water characteristics on fish communities. Our results show that, in interaction with underwater hydrodynamics, ambient sounds are important descriptors of fish activity under the ice sheet, especially for walleye and yellow perch species. Our work is seminal in studying the ambient soundscape of a shallow fluvial lake during winter, which is an underexplored yet critical period for fish survival

Introduction to Symposium

Tobias Plieninger, University of Copenhagen; Schulp, Verburg

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Discussion with Symposium Organizers

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Transition of Ulmaceae forests and trees in Kyoto city

Motonori Kimura, Kyoto University, Kyoto, Japan; Shozo Shibata, Kyoto University, Kyoto, Japan*

For planning of the urban green network, it is important to evaluate remnant green spaces from the view point of configuration and composition. In Kyoto city, there have been many Ulmaceae forests and isolated trees on plain area. It is because Kyoto city locates on the flood plain and this geographic condition is suited to regeneration of Ulmaceae trees. In addition, citizens consciously keep big Ulmaceae trees by the reason of their animistic customs. Thus, in Kyoto city, Ulmaceae forests and trees have existed as a natural and cultural landscape component. Recently, however, urban expansion caused reduction of Ulmaceae forests within shrines and temples (Sakamoto 1988). Moreover, Tabata (2004) suggested that the flood control have interfered regeneration of Ulmaceae trees and camphor trees would dominate in atypical Ulmaceae forest in Kyoto city. This study is designed to assess the transition of Ulmaceae forests and trees in Kyoto city as a follow-up study of Sakamoto(1988). The results showed that the area of each Ulmaceae forests has reduced and the forests more isolated. Some isolated Ulmaceae trees were cut because of the changes of citizen's consciousness to big Ulmaceae trees.

Mapping global vegetation dynamics during 1981-2010 using polynomials analysis

Yanxu Liu, College of Urban and Environmental Sciences, Peking University; Yanglin Wang, College of Urban and Environmental Sciences, Peking University; Jian Peng, College of Urban and Environmental Sciences, Peking University*

Fitting the trend of long time series NDVI has become an effective way in detecting vegetation variability under global environmental change. With the overwhelming majority of NDVI series are nonlinear, using â€œgreeningâ€ or â€œbrowningâ€ description by linear fitting methods may ignore some

â€œlatentâ€ variations. Combining high order regressions with a nonparametric linear regression in stepwise, a global greening with regional browning trend has been identified. Many of the regions with high densities of human activities experienced a vegetation restoration process during the recent 31 years, while arid areas with sparse vegetation suffered from vegetation degradation. 34.62% of the pixels were reassigned to new variation types in the polynomials analysis in contrast with the traditional linear fitting result. In North America, there were notable concealed trends that encompassed more than 19% of the total pixels. The high order pixels were more than 40% on sparse vegetation cover. In China, the apparently cubic fluctuation of the vegetation in the region joining Ordos City and the Shaanxi Gansu Ningxia region on the Loess Plateau might be indicative of the occurrence of a restoration-degradation-restoration process, which could be contributed to Grain for Green and Natural Forest Protective project. The positive correlations between vegetative variation and precipitation change were more common in northern China, while the positive correlations between vegetative variation and temperature change were more common in southern China. Because NDVI cannot be directly correlated with social factors, obstacles still exist in measuring the response of human activity.

Climate change adaptation to assist range shifting: the key considerations for achieving long term conservation goals at a landscape-scale

Nicholas W. Synes, University of Southampton; Kevin Watts, Forest Research, UK; Stephen Palmer, Kamil Barton, Greta Bocedi - University of Aberdeen; Patrick Osborne, University of Southampton; Justin Travis, Institute of Biological and Environmental Scien

Guidance for the selection of climate change adaptation strategies has previously been almost entirely case study specific or purely theoretical, focusing on small-scale experimental set ups for single species or abstract simulation models. Using RangeShifter, a novel modelling platform which combines population dynamics with individual-based dispersal behaviour, this study tests climate change adaptation strategies across a number of real landscapes with different habitat configurations, different levels of prescribed change, and a number of broadly representative species parameterisations. Future landscapes were created to represent the spatial application of adaptation strategies such as habitat improvement, restoration, creation and landscape matrix modifications. The relative success of each adaptation strategy was measured by the range-shifting potential of the study species in each landscape over a 100 year period. The study provides guidance on the best climate change adaptation strategies for achieving long term conservation goals at a landscape scale. In particular, it demonstrates the importance of the quantity of land prescribed for adaptation: with conservative levels of change, biodiversity benefits are limited. The importance of the existing landscape configuration is another important factor in determining the best adaptation strategy for a region. The study also demonstrates the importance of species characteristics in determining the success of different climate change adaptation strategies, and highlights the key characteristics that should be considered. Finally, the importance of the spatial location of adaptation actions is discussed, pointing to a need for the consideration of the habitat growth time-lag in future studies.

Adding the Z-axis to Dendrochronology by Sampling Tree-Branch Fire-Scars

Brett R. Goforth, California State University San Bernardino

In mixed conifer forest ecosystems of western North America, dendrochronology studies of fire-scarred tree-rings indicate the understory had been recurrently burned before fire suppression management. A central question concerns analysis of burn intensity from fire-scars: can small low-intensity surface fires (micro-burns) be differentiated from larger intense understory fires (mass burns)? Tree-ring samples are traditionally collected near ground level from scarred trunk bases over an array of sample points having

(x,y) coordinates in a 2-dimensional Cartesian plane at the land surface. I add the z-axis, i.e., vertical dimension, to dendrochronology for enhanced analysis of burn intensity using samples of tree-branch fire scars found at heights near the crown base. This new approach compares trunk-rings with branch-rings to match fire-scar pairs caused by high burn intensity. A study of 27 fire scarred Jeffrey Pine (Pinus jeffreyi) was conducted in the remote Sierra San Pedro Martir of Baja California, Mexico where systematic fire suppression had not been practiced. Trees with 5 to 10 m scorch heights were sampled in 3 mass burns independently dated by aerial photography. Results confirmed scars in branch-rings matched trunk-rings. Analysis of tree-branch fire-scars raises new potential to map landscape patterns of burn intensity in mixed conifer forest.

Monitoring and Assessment of Soundscapes in Landscapes: A Systems Perspective

Stuart H Gage, Michigan State University*

Sounds that a landscape emits are becoming an important way to characterize dynamic components of a landscape. The objective of this symposium is to present papers about the connection between the landscape and the soundscape. New sensor technology is enabling the collection of large numbers of recordings and new metrics are being developed to analyze the soundscape. This presentation provides an approach for addressing landscape-soundscape linkages. We must address the number and timing of sound recordings, collection methodology, processing sounds into metrics for analysis, archiving the recordings and the associated metrics to provide an historical record of soundscape change and access to the soundscape information using network technologies. This requires a systematic approach to ensure that all components are integrated in order to accomplish the questions posed about the landscape-soundscape connectivity and the processes necessary to achieve this linkage. The discipline of System Science provides a pathway to problem solving using systems principles. The steps include careful definition of the problem, characterization of the components of the system, linking the components, examining the flow of information between components and modeling to determining if the system is complete. A framework for the process of the soundscape-landscape linkage is presented.

How can natural environments contribute to restoration and what kind of natural environment is best suited to foster restoration and well-being?

Nicole Bauer, Economics and Social Sciences, Social Sciences in Landscape Research, Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Birmensdorf, Switzerland; Dorte Martens, University of Potsdam, Germany; Marcel Hunziker, Economics a*

In a first part of the presentation we will give detailed insight in the psychological concept of restoration and the most important theory on restoration originating from environmental psychology, the attention restoration theory (Kaplan and Kaplan, 1989). This theory explains how and why a landscape evoking feelings of Fascination, Being away, Coherence, Extent and Compatibility can foster the restoration process. In a next step we will present some of the methods used to assess the (level of) restoration and/or wellbeing of the individual, e.g. the Perceived Restorativeness Scale (Berto, 2005). Additionally we will give some detailed insight into empirical evidence from different quasi-experimental studies and population surveys. As it is well proven that the natural environment is better suited to foster the well-being and restoration of the individuals than urban environments, we will go one step further and analyze the influence of different physical environments, such as green and blue spaces as well as different combinations of both (White et al., 2010), and wild and tended urban forests (Martens et al., 2011) on restoration and well-being. The results will give important advice how to design natural areas serving restoration and public health, especially for people living in urban environments.

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Influence of landscape structure on the provision of disease-regulating ecosystem services.

Elizabeth Nichols, University of SÃ£o Paulo, Brazil, Swarthmore College, USA Jean Paul Metzger, University of SÃ£o Paulo, Brazil*

Understanding the implications of land-use change for the risk of infectious disease transmission is an ongoing social and environmental challenge. Infectious disease dynamics are inherently influenced by diverse aspects of landscape structure, through their combined and non-linear effects on the community diversity, population density and contact rates between the multiple components of a given transmission cycle. However, the patch-scale focus of much of the existing work that links land-use change to infection risk outcomes prevents general conclusions regarding the influence of landscape structure on transmission risk. Combining insights from landscape and disease ecology, we identified general principles that relate landscape attributes, transmission strategies, and community-wide distributions of transmission-relevant species traits. We develop these principles into a general, trait-based framework aimed at improving our ability to understand the impact of (i) biodiversity thresholds, (ii) habitat connectivity, and (iii) habitat edges on the transmission of four distinct transmission strategies. We then use this framework to review the existing body of landscape-epidemiology work, to highlight ways in which the incorporation of landscape structure may allow a better understanding of how to manage landscapes for the provisioning of disease-regulating ecosystem services.

People in Ecosystems/Watershed Integration (PEW)I: A dynamic land-use and ecosystem service tradeoffs assessment tool

Carrie M. Chennault, Iowa State University; Lisa A. Schulte, Iowa State University; John C. Tyndall, Iowa State University; John K. Van Dyk, Iowa State University; Ryan Frahm, Iowa State University*

Students at Iowa State University participated in classroom use of an online, open-source educational tool to explore relationships between land use, watershed biophysical properties, climate, and ecosystem services. We developed this tool, People in Ecosystems/Watershed Integration v2 (PEWI), to teach complex interactions between humans and ecosystems through interactive simulation of land use and management in a fictitious agricultural watershed. PEWI puts users in the driver's seat to creatively imagine alternative land-use configurations and experiment with agricultural and environmental tradeoffs. While PEWI integrates large amounts of spatial and temporal data and covers scientific concepts spanning multiple academic disciplines, its intuitive interface allows students to master complex social-ecological concepts without delving into details underlying those relationships. Using PEWI, students iteratively assess information, design land-use configurations, evaluate feedback on outcomes, and make improvements. Innovatively, the design of PEWI focuses on visualizations and dynamic plots throughout the process, with numerical outcome data available but not required for students to master the tool's learning objectives. Thus, PEWI empowers students to better visualize market and non-market environmental outcomes of land-use decisions. The sixteen ecosystem outcomes in PEWI include production outcomes (e.g., crops and livestock) and environmental outcomes, such as nutrient and sediment levels in water, habitat provision for biodiversity, soil erosion, and carbon management. We will discuss our experiences from classroom use of PEWI, its potential to reframe decision making, and future directions and applications for the tool.

Mountain forest fires and ecosystem services: impacts, cross-scale connections, and the development of an explicit assessment framework.

Jelena Vukomanovic, INSTAAR - CU Boulder; Patrick S. Bourgeron, INSTAAR - CU Boulder*

The increased presence of people in the Colorado Front Range due to residential development (exurbanization) and recreation, along with increasing disturbances such as fires and insect outbreaks, can lead to decreases in key ecosystem services (ES). ES are the benefits that people obtain from their environment and can provide a transdisciplinary perspective of social-ecological systems (SES), wherein ES link social and ecological components. In fire-prone landscapes, understanding the changes to ES from fire is critical to characterizing the sustainability of SES. We review the connections between ES and fire and assess the cumulative impacts (both positive and negative) and trade-offs that may result from these connections in the context of residential development. We present a conceptual and methodological approach for characterizing and evaluating these connections, for improving assessment of impacts, and for identifying knowledge gaps, research priorities, and challenges. Exurban development and other land-use changes interact with fire and impact ecosystems through spatially distributed processes at multiple spatial and temporal scales, resulting in trade-offs between ES. Improved assessment of impacts and connections can help address the challenge of predicting and managing changes to ecosystem function under changing land-use patterns and can help guide scenario-testing, stakeholder engagement, planning, and decision-making.

Spatial patterns of human well-being and ecosystem services: A multi-scale analysis in Beijing, China

Ganlin Huang State Key Laboratory of Earth Surface Processes and Resource Ecology (ESPRE), Beijing Normal University

Human well-being and ecosystem services are key concepts of sustainability. Understanding the spatial distributions of human well-being and ecosystem services, and their interactions are crucial for urban sustainability. Here, we present the results from a multi-scale study in Beijing, China to explore spatial patterns of human well-being and ecosystem services and further examine their relationships. We assessed human well-being and ecosystem services at three scales: neighborhood, community (Jiedao or sub-district) and district. Neighborhood refers to an enclosed residential area by the same developer. It often is composed by buildings and some public space. Community and district are administrative units where census and other statistic data are collected. Beijing has 16 districts, and approximately 300 communities and 20,000 neighborhoods. We focused on ecosystem services provided by urban green space, which are directly related to local residents. We used vegetation cover extracted from ALOS satellite imagery with spatial resolution of 2.5m collected in 2010 to evaluate ecosystem services provided by green space. Human well-being was evaluated based on census data at the community and district level, and on field survey data at the neighborhood scale (N=70). The spatial distributions of distributions of human well-being and ecosystem services, and their interactions were further evaluated using spatial analysis. We found: 1) there were large variations in ecosystem services and human well-being among neighborhoods, communities and districts; and 2) in general, there was a positive relationship between human well-being and ecosystem services provided by urban green space, but the relationship changed across scale.

Beaver Alteration of Landscape Connectivity: A Graph Theory Approach

Carol A Johnston, South Dakota State University

Beavers (Castor canadensis) increase the connectivity of boreal aquatic landscapes by creating small ponds that are interspersed among permanent lakes, increasing the number, total area, and proximity of water bodies. Water bodies within a 250 km2 study area in northern Minnesota were mapped using 12 sets of aerial photographs taken between 1927 and 2005, a period of expanding beaver population, and graph theory methods were used to quantify their connectivity. The critical distance of network coalescence shortened from 4 km prior to beaver occupation to less than 1.6 km by 1961, although

pond density did not peak until 1997 at 2.6 water bodies/km2. Prior to beaver colonization, lakes were the only stepping-stones (sites with outsized importance in maintaining network connectivity), but beaver ponds increasingly served this purpose as their density in the landscape increased. The network backbone was located in approximately the same area from 1981 through 2005, but concentrations of hubs (nodes with a large number of connections to other ponds within the critical distance) shifted from year to year. The increased connectivity of the beaver-impounded landscape could enhance habitat for semi-aquatic organisms by decreasing the length and increasing the choices of overland travel routes.

Landscape Epidemiology of Lyme Disease: How Landscape Spatial Heterogeneity Mediates The Spread Potential of Ixodes Scapularis and Borrelia Burgdorferi

Alexander G. Watts, University of Toronto; Santiago Saura, Universidad Politecnica de Madrid; Claire Jardine, University of Guleph; Patrick Leighton, Universite de Montreal, Canada; Lisa Werden, University of Guleph, Canada and Thousand Islands National P

Dispersal processes are central to the epidemic spread of pathogens in natural populations. In the case of Lyme disease, movement of the pathogen (Borrelia burgdorferi) is directly linked to the dispersal of its tick vector (Ixodes scapularis) and to the spatio-temporal dynamics in fragmented habitats of the wildlife host community upon which both parasites depend. However, we still lack a synthetic empirical understanding of the relationship between landscape spatial pattern and ecological processes that determine vector-borne persistence and spread. Here, we estimate, using a generalized connectivity network model, the spread potential of B. burgdorferi in a heterogeneous landscape using a simplified vertebrate host community. We parameterized the network model using observed B. burgdorferi-prevalence in tick and white-footed mice populations sampled from Thousand Islands National Park (Ontario, Canada). Host burdens and dispersal parameters were estimated from the literature. We modeled the probability of infected tick connectivity by white-footed mice (infected and uninfected), American robins, and white-tailed deer dispersal abilities, given habitat configuration. Our results demonstrate that (a) the relative capacity of hosts to influence the spread of B. burgdorferi are differentially affected by landscape spatial structure; (b) intermediate stepping-stone habitat is critical for maintaining pathogen invasion flux in fragmented habitat; and (c) vector-borne pathogen invasion can be limited by demographic-dispersal interactions shaped by variability in habitat configuration. Our work underscores the insufficiently studied role of landscape spatial structure in the spread of vector-borne disease towards more accurate predictions of local vector-borne disease spread in future climate and land use changes.

Herbaceous understorey - an overlooked player in forest landscape dynamics?

Timothy Thrippleton, Forest Ecology (ETH Zurich); Harald Bugmann, Forest Ecology (ETH Zurich); Kathrin Kramer-Priewasser, WSL Birmensdorf; Rebecca Snell, Forest Ecology (ETH Zurich)*

Herbaceous understorey vegetation (i.e. grass, ferns, forbs and herbs) can play an important role in the functioning of forest ecosystems, by competing with trees for light and soil resources. In natural and managed forests, dense understorey layers can reduce tree establishment, and it has been claimed that this may delay, shift or even halt forest succession. However, a quantitative substantiation of such long-term effects is largely lacking. Forest landscape models provide an important tool to assess species interactions and forest dynamics. To date, however, they typically do not include an herbaceous understory layer, although a growing number of empirical studies emphasize its importance for tree establishment and growth. We used the forest landscape model LandClim to assess the long-term effects of understory-overstory interactions between trees and the herbaceous layer. Simulation results show a strong effect of the herbaceous layer on forest dynamics. The presence of herbaceous

vegetation can delay tree establishment by several decades, depending on environmental conditions within the landscape. However, no evidence for halting succession was found. The magnitude of the impact on forest succession depends on terrain-specific aspects (in particular elevation), emphasizing the importance of considering the landscape scale when investigating understory-overstory interactions.

A typology of cultural landscapes and patterns of landscape change

Koen Tieskens, Peter Verburg, Nynke Schulp, Emma van der Zanden, Julia Stuerck - VU University Amsterdam*

Cultural landscapes are characterized by the landscape structure (land use composition and configuration), the values assigned to the landscape, and the landscape history. Based on these different dimensions a spatial typology of cultural landscapes at continental scale was derived using available proxy data. The data used include traditional land cover and land use data, information on landscape elements, land use change reconstructions and landscape preference studies. Based on scenario simulations of future changes in land cover and land management intensity arche-typical changes and threats to cultural landscapes were identified and overlaid with the landscape typology to identify the respective risks of the different landscape types. Overall, the ongoing polarization and specialization of land uses as well as peri-urban development are most threatening the quality of cultural landscapes. Different processes of change affect the structure, value and history of the cultural landscapes, often leading to a loss of its cultural value.

Environmental influences on pathogen spillover in a multi-host forest disease

Whalen W. Dillon, North Carolina State University; Ross K. Meentemeyer, North Carolina State University*

Disease transmission is heterogeneous across individuals, species, and landscapes in space and time. In some disease systems, transmission is driven by an alternate amplifying host in a process called pathogen spillover. Spillover is frequently associated with multi-host disease systems where a single species is substantially more competent in terms of pathogen transmission. Aggregations of these hosts under environmental conditions favorable to the pathogen then results in disease amplification. We investigated how environmental variation in space and time influences pathogen spillover in the multi-host forest disease sudden oak death. This disease kills tanoak and some oak species in coastal forests of California and Oregon, but pathogen transmission is largely driven by an alternate amplification host, California bay laurel. We applied path analysis to examine the influence of the local environment on pathogen spillover. Using 10 years of data from 200 ecological monitoring plots located across a 275-km2 study area, we modeled the direct and indirect effects of weather conditions and plant community composition on spillover potential from bay laurel and the subsequent infection of oak species for each year. With this approach we confirmed that infection of oak species is directly affected by weather and spillover, and that spillover is directly influenced by weather conditions and the plant community. These results indicate that co-occurrence of susceptible hosts with the amplification species may not be sufficient for transmission of epidemic diseases driven by pathogen spillover, but that transmission simultaneously depends on favorable environmental conditions for the pathogen.

Introduction to Symposium

Frederik Doyon, Institut des sciences de la foret temperee, Universite du Quebec en Outaouais

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Spatial-temporal dynamics of water use efficiency and associated meteorological factors in China's Loess Plateau during 2000-2010

Jian Pengï¼ŒCollege of Urban and Environmental Sciences, Peking Universityï¼›Tian Zhang ï¼ŒCollege of Urban and Environmental Sciences, Peking Universityï¼› Wei Liangï¼ŒDepartment of Tourism and Environmental Sciences, Shaanxi Normal Universityï¼› Yanxu*

Accurate assessments of spatial-temporal variations in water use efficiency (WUE) play a crucial role in evaluating carbon and water balance. In this paper, utilizing remote sensing data and multiple statistical methods, carbon sequestration was evaluated using CASA model to quantify WUE in the Loess Plateau from 2000 to 2010. Particular focus was applied to WUE temporal and spatial dynamics and the impact of various meteorological factors among five ecological zones and variegated biomes. Results identify the regional mean NPP as 310.03gC/m2â€¢yr for 11 years with an annual increase of 7.59 gC/m2â€¢yr or 2.59%. The change in ET may be segmented into three stages: growth (2000~2003), decline (2004~2006) and stable (2007~2010). The average WUE was measured at 0.915gC/mmâ€¢m2â€¢yr, demonstrating an increasing trend at the rate of 0.027 gC/mmâ€¢m2â€¢yr, and improving 2.55% from 2000 to 2010. Spatially, both NPP and WUE shows a gradient decreasing from southeast to northwest, but rising particularly sharply in northern Shaanxi. Furthermore, the ecosystem had the highest WUE growth rate (0.96%) with the arid desert zone in northwestern Loess Plateau, reflecting that vegetation in moderately water-deficient areas may have a higher capacity to adjust to drought. Among different meteorological factors, WUE has a general positive correlation with solar radiation, and increased commensurately with higher temperatures and precipitation. Finally, a significant variation in vegetation WUE sensitivity in response to meteorological factors is noted. Temperature proved the dominant driving factor of bush WUE, while precipitation more significantly influenced grassland, cropland and woodland WUE.

Soil and Terrestrial Carbon Space-Time Trajectories in the United States

S. Grunwald" (and research team), University of Florida

Over the past decades a changing climate, land use shifts, and socio-economic development have had a tremendous impact on the spatial and temporal variation of soil and terrestrial carbon in the U.S. Given the complexity and heterogeneity of large soil-landscapes, research gaps still exist to quantify soil and terrestrial carbon concomitantly. We synthesized historic to current (~1925 to 2012) soil organic carbon (SOC), above-ground biomass carbon, and 750+ geospatial temporal environmental data layers for the U.S. into an integrative carbon model. Our specific objectives were to: (1) Assess spatial and temporal trends in SOC stocks, (2) Elucidate on the interrelationships between climatic factors, land use/land cover, SOC and biomass carbon in the U.S. This study spawns a soil-landscape of about 9.8 million square kilometer covering diverse climatic zones (from semiarid to wet tropical), a multiplicity of biomes, land uses, and management types that have generated a diverse mosaic in SOC from less than 10 Mg ha-1 to more than 3000 Mg ha-1 (0-100 cm). In many geographic regions in the U.S. carbon stored in soils is substantially (2-4 times) larger than in biomass. However, substantial geographic variations in soil and terrestrial carbon occur. The SOC stock mean value for 1920-1930 was 5.8 kg m-2 in the 0-100 cm profile; while the current one is 31 kg m-2 (2000-2011), though substantial fluctuations in SOC were observed since the early 1920s in the U.S. These findings allow identifying suitable adaptation and management options to optimize natural carbon capital in context of imposed natural and anthropogenic induced changes.

A meta-modeling framework for integrating stand and landscape processes under climate change in the boreal forest

Colin Daniel, Dept. of Ecology & Evolutionary Biology, University of Toronto; Marie-Josee Fortin, Dept. of Ecology & Evolutionary Biology, University of Toronto*

There is considerable uncertainty regarding the effect climate change may have on the structure of tree communities in the boreal forest. Numerous possible pathways exist through which climate change could impact the boreal forest, including the direct effect of changes in abiotic factors (e.g. temperature and precipitation), the indirect effect of changes in disturbances (e.g. wildfire and timber harvest), and the effect of changes in biotic interactions (e.g. interspecific competition, seed dispersal and local adaptation). To-date analyses of the possible effects of climate change have generally been limited to consideration of only one or two possible factors at a time, often at a single scale; as a result the full range of potential interactions is not considered. Here we present a modeling framework designed specifically to explore the role of interactions between abiotic and biotic factors, from stand to landscape scales, in altering the distribution and abundance of boreal tree species under a changing climate. Our "meta-model" framework allows for the integration of multiple processes operating at different spatial and temporal scales, including the ability to abstract the complexity of fine-scale processes to coarser scales. We demonstrate this meta-model approach by applying it to a 10,000 km2 landscape in the boreal forest of Ontario, Canada. Processes represented in our meta-model include continental shifts in climatic conditions, landscape-level dynamics of natural and anthropogenic disturbances, and stand-level changes in tree growth, mortality and interspecific competition.

Ecosystem services - sustainable solution or another wicked problem for decision makers?

*Christine Furst *, University of Bonn, Center for Development Research (ZEF)*

The science-political perception of ecosystem services (ES) as a convincing and holistic concept to better explain the value of nature of human beings has experienced an outstandingly fast development. Actors, who introduce, advance and adapt the concept to the manifold questions and application areas in policy consulting, and planning and decision making processes, benefit from its advantage as an "internationally communicable currency" for assessing how sustainable the use of natural resources really is. Lessons learnt from ES application in regional and rural planning, however, teach that there is still a large need to include better socio-cultural and economic constraints advancing the original concept towards "socio-ecological services". These would have the potential to reflect much better the uniqueness of socio-ecological systems and enable an equal attraction and cooperation with all kind of actors. With this presentation, experiences from using the ES concept in different EU regions are critically reviewed. Needs for further development for better respecting the balance between provision and demand are formulated and conclusions are drawn how the concept of ES could be advanced in favour of a large and publicly well acknowledged applicability in complex socio-ecological system development questions.

Applying Ecosystem Services in Landscape Planning: An Adapted Framework, Case Study and Implications

Christian Albert, Leibniz Universitat Hannover & Helmholtz Centre for Environmental Research - UFZ; Carolin Galler, Leibniz Universitat Hannover; Johannes Hermes, Leibniz Universitat Hannover; Felix Neuendorf, Leibniz Universitat Hannover; Christina von H

Applying ecosystem services (ES) concepts and indicators in landscape planning requires them to be linked with instruments for decision-making by practitioners. The objective of this contribution is to introduce an ES-in-Planning framework which combines ES assessment and valuation indicators with the widely used Driving Forces, Pressures, State, Impacts and Responses (DPSIR) model. Within this

framework, ES indicators become part of landscape planning as a means of assessing the current state of the environment and how it might change in the future. The implementation and added value of the framework is illustrated in a case study of planning issues in the Mardorf community bordering the Steinhuder Meer lake, Northern Germany. Two scenarios of potential landscape changes and possible response measures are considered in terms of alterations in a set of ES indicators. The ES examined are climate mitigation (a regulation ES), landscape aesthetics (as the basis for many cultural ES), and biodiversity. The ES indicators employed distinguish between all those services valued by humans and those which are actually utilized. Valuation of changes in ES reflects societal objectives (as institutionalized in legal requirements), expert-based estimates, and economic impacts. The added value of applying ES in the planning process lies in improved opportunities for developing targeted response measures, for communicating trade-offs between planning options and for facilitating joint implementation by partners.

Assessing local adaptation and gene flow in an endemic, montane salamander threatened by climate change

Brenna R. Forester, Duke University - University Program in Ecology; Dean L. Urban, Duke University - Nicholas School of the Environment; Thomas F. Schultz, Duke University - Division of Marine Science and Conservation; Jennifer J. Wernegreen, Duke Unive*

Faced with climate change, organisms either adapt in place or move-or they go extinct. Relative to dispersal, adaptation in response to environmental change remains poorly understood. Fortunately, the recent development of molecular techniques for detecting adaptation in wild populations has made it easier to evaluate this response. We are using reduced representation, next-generation sequencing in combination with multivariate statistical methods to identify and understand spatial patterns and environmental drivers of local adaptation and gene flow in an endemic salamander. Plethodon welleri is a fully terrestrial salamander (lacking lungs and breathing through its skin) and is a species of conservation concern across its small range in the Southern Appalachian Mountains. Our analysis of neutral single nucleotide polymorphism (SNP) markers indicates significant differentiation in P. welleri populations both across mountain peaks and within elevation gradients indicating restricted gene flow. Additionally, these populations show a signal of local adaptation at SNP markers potentially under selection based on temperature proxies. We are currently integrating genetic, environmental, and spatial data in a common analytical framework using a Bayesian model to assess the covariance in neutral and adaptive allele frequencies as functions of geographic and environmental distances. These analyses will help us better understand the capacity of species to adapt to changing conditions and what actions will be most effective to conserve salamander biodiversity under global change. Additionally, our approach is applicable across taxa and montane systems, where the distribution of species on mountain peaks provides a naturally replicated environmental gradient for distinguishing local adaptation.

Temporal tradeoffs between short-run and long-run benefits of forest ecosystem services in the Mulan Paddock, China

Huiling Lv,School of Urban Planning and Design, Shenzhen Graduate School, Peking University; Jian Peng*,College of Urban and Environmental Sciences, Peking University; Yanxu Liu*,College of Urban and Environmental Sciences, Peking University; Xin Chen,Sc*

The tradeoff of different ecosystem service, mainly about spatial scale, temporal scale, and reversibility is a hot topic in the study of ecosystem service field. However, most of studies specific to spatial tradeoff and few are focused on temporal tradeoff which describes how short-run ecosystem service demands effect long-run ecosystem service supplies. On a temporal tradeoff view, in this paper we chose Mulan

Paddock, one of the Chinese famous royal park, which was in disparity between local social development and natural ecological protection. Firstly, we used Granger Causal Relation Test method to quantitatively identify the causal relationship among forest ecosystem service, resident income and forest protection based on forest coverage remote sensing data and household survey data. Then two variables, the single timber revenues and multiple income were acted in time axis. In addition, TOPSIS method was used after time-series study of ecosystem services value, resident income sources and resident total income to clear temporal tradeoff characteristics. The results proved that forest coverage increased in the Mulan Paddock since the establishment of nature reserves. Meanwhile, forest ecosystem service value in regional scale and resident income in individual scale had both increased. And the development of relevant industries derived by tourism diversified the sources of resident income. We came to a conclusion that Mulan Paddock protection program is a successful temporal tradeoff example of government paying landholders to increase human well-being through forest conservation. Also program evaluation highlighted the importance of considering behavioral changes for "win-win" scenario building.

Patterns of fire refugia across climate gradients in landscapes of western US and Canada

Sandra L. Haire, Haire Laboratory for Landscape Ecology; Carol Miller, Aldo Leopold Wilderness Research Institute; Ellen Whitman, Northern Forestry Center, Canadian Forest Service; Marc-AndrÃ© Parisien, Northern Forestry Center, Canadian Forest Service*

Wildland fires can leave behind unburned refugia within their perimeters that serve as safe havens for species and communities, thus forming a template for resilience in mountainous regions. To explore where these â€œfire refugiaâ€ occur in areas of northwestern US and southwestern Canada, we developed a climate space of the region using principal components analysis of 12 climate layers, stratified the space into bins, and selected the largest fires across bins to represent a consistent proportion of area burned in each bin. We hypothesized that some regions of the climate space would be more closely associated with potential refugia than others, defined by clustering of low-change values of pre- to post-fire Landsat imagery. Regionally, presence of potential refugia responded positively to areas of the climate space with greater winter precipitation. Within individual fire events, models of refugia probability suggested the importance of microclimates in complex terrain. Significant predictors of refugia presence in three case study fires included catchment height and slope, topographic wetness index, and incoming solar radiation. Along ravines and ridges, predicted refugia had linear shapes whereas on steep slopes they were more circular. The shape and size of refugia hold significance for the ecological function of these places in the short and long term. We propose that promotion of the formation and maintenance of refugia be integrated into resource management planning.

Green infrastructure planning in Portugal: looking for suitable governance models

Isabel Loupa Ramos, Instituto Superior Tecnico - University of Lisbon, Portugal; Jorge Batista e Silva, Instituto Superior Tecnico - University of Lisbon, Portugal; JoÃ£o Corgo, Instituto Superior Tecnico - University of Lisbon, Portugal

There is vast literature on the multiple benefits of integrating green infrastructures (GI) into urban and regional planning. There is also worldwide experiences on the integration of GI into planning practice notably. The pool of experiences diminishes and the success stories are very diverse when addressing implementation and management in ways that GIs are capable to bring out its potential. In this paper we are looking in depth into the Portuguese experience. Since 1999 that planning law demands the integration of GI (in the legislation called Ecological Structures) in Municipal Master Plans. Within the

Portuguese planning system the Municipal Master Plan (MMP) plays a prominent role due to its normative nature, providing the regulatory basis for land use change. Unlike other countries, in Portugal the Municipal Master Plan covers both urban and rural areas. We investigated thoroughly how GI are being taken into consideration in 69 MMP recently approved and by using systematic approach to review local planning documents. Results showed that besides the geographical limits on the land use zoning map little regulation was provided. Following these findings we argue that for ensuring the implementation of GI, notably outside urban areas a costume-tailored management plan is needed based on a governance model that builds on local stakeholders in defining priorities by valuing ecosystem services and finding financial opportunities, both taking advantage of public financing schemes from multiple sector - i.e. agriculture or cohesions funds - as well as private partnerships.

Biodiversity and Landscape Structure - Landscape and Species diversity

Ulrich Walz, Leibniz Institute of Ecological Urban and Regional Development; Christian Stein, Leibniz Institute of Ecological Urban and Regional Development*

The diversity of genes, species, ecosystems and landscapes are strongly interrelated levels of biodiversity. Against this background, for example, species diversity can only be ensured if heterogeneous and diverse landscapes and ecosystems are maintained. Indicators are necessary to describe the state and change of biodiversity for better management of landscapes in order to maintain biodiversity. The characteristics of ecosystem and landscape diversity can be described on the basis of land use structure. The contribution will show examples on the linkages between species and landscape diversity. Furthermore an overview of various indicators on landscape diversity and heterogeneity currently used in Germany and Europe will be given. Based on these indicators a complementary system will be presented in which the focus is on indicators on land use diversity and landscape structure. Examples are ecotones, forest fragmentation, naturalness (resp. hemeroby) and the Shannon diversity index. Also an indicator on landscape attractiveness for human recreation was developed. If it is possible to derive data on species diversity from landscape structure, specific landscape management goals for a particular landscape context could be formulated. The indicators were also used to analyze the effectiveness of landscape planning in Germany.

Informing climate adaptation strategies with ecologically-relevant landforms and physiographic diversity

**David M. Theobald, Conservation Science Partners; Dylan Harrison-Atlas, Colorado State University; William B. Monahan, Inventory and Monitoring Division, National Park Service; Christine M. Albano, Conservation Science Partners*

Key to understanding the effects of climate and land use changes on biodiversity is incorporation of the physiographic platform on which changes in ecological systems unfold. We will describe a detailed classification and high-resolution map of landforms and physiography that excludes dynamic variables (biotic or climatic) to prevent confounding current biodiversity patterns with enduring features, allowing greater relevance to climate adaptation planning. To illustrate the application of this work, we mapped the location of 15 major landform types and 269 physiographic types in the US and describe potential uses in climate change adaptation planning by identifying readily-available physiographic indicators and by calculating correlations with common empirical measures of biodiversity: vertebrate species richness (0.445) and ecological systems (0.285), and that landform diversity is correlated with current temperature variability (0.484) and strongly with climate velocity (0.792). We found that characterization of landforms is particularly sensitive to scale and recommend using high-resolution

datasets when possible and, generation of metrics at multiple scales to minimize potential unknown biases.

Modeling gopher tortoise habitat in Georgia and analyzing the role of private landowners in tortoise conservation

Rachel Bormann, Warnell School of Forestry and Natural Resources, The University of Georgia; Jeffrey Hepinstall-Cymerman, Warnell School of Forestry and Natural Resources, The University of Georgia; Laura German, Franklin College of Arts and Sciences, De*

The gopher tortoise (Gopherus polyphemus), a keystone species, is a candidate for federal listing as threatened for the eastern population (including Georgia) of its range in the southeastern U.S. We examined conservation of the tortoise in Georgia in three stages. First, we modeled tortoise habitat suitability in Georgia using publically available GIS layers representing known tortoise habitat characteristics (soils, land cover, fire frequency) and field data on tortoise burrow locations using an ensemble modeling approach (MAXENT, logistic regression, and Random Forests). Second, we estimated habitat connectivity using Circuitscape and Linkage Mapper. Results of these analyses are being fed into a Bayesian population model (see Nuse et al. abstract). Third, we are investigating the effectiveness of landowner incentive programs in Georgia through interviews of private landowners and personnel in key government agencies (National Resource Conservation Service and GA Department of Natural Resources). Our objective here is to understand under what conditions various types of private landowners participate in conservation incentive programs, particularly Working Lands for Wildlife, an incentive program that specifically targets habitat improvement for the gopher tortoise in its range. Using approximately 15,300 known burrow locations across 60 sites, we predict less than 10% of the study area is of moderate to high-quality habitat. Connectivity of habitat patches is highly variable, with major river systems and interstate highways acting as strong barriers and large swaths of unsuitable habitat, primarily intensive agriculture, acting as secondary barriers. Incentive programs have differential appeal to landowners based on several demographic traits and management goals.

Is Portugal's forest transition going up in smoke?

Tiago M. Oliveira, (Centro de Estudos Florestais, Instituto Superior de Agronomia, Universidade de Lisboa.) Nuno Guiomar, (ICAAM - Instituto de Ciencias Agrarias e Ambientais MediterrÃ¢nicas, Universidade de Ã‰vora) Jose M.C. Pereira, (Centro de Estudos*

Many European countries experienced forest transition processes during the 20th century. Portugal is a remarkable case, with afforestation expanding from 14% to 38% of the country total area between 1874 and 1995, but then decreasing to 35% by 2010. Wildfires burned thousands of hectares of forest and are regarded as the main cause of forest loss. This study investigates where, de facto, forest transition happened and how it relates to wildfire. We examined the interplay between forest transition and burnt area using land cover maps from 1910 to 2007 and a fire perimeter atlas (1975-2009). After thematic and geometric harmonization, landscape metrics were computed at county level to evaluate changes in landscape structure and composition and a transition matrix was constructed to assess land cover dynamics. Forest transition shows regional patterns: in the central coastal and southern plains, a mosaic of intensive agriculture and agro-forestry supported the forest transition process; in littoral central and northern mountains, where urbanization has not competed for soil and forestry is still profitable, the forest transition has shown to be resistant; in the less productive interior mountains afforestation investments were not maintained and recurrent fires re-established the shrublands. Results also show that higher fire incidence is related to shrubland encroachment and cropland contraction, and not fully explained by the expansion of afforested areas.

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Distribution of biological soil crusts in adjacent sagebrush and pinyon-juniper communities of the Walker River Basin, western Nevada, USA.

Stephanie Freund, University of Nevada, Reno; Jill Heaton, University of Nevada, Reno*

Biological soil crust communities in North American arid and semiarid landscapes are increasingly receiving attention because of their role in soil stabilization, protection against erosion, and biogeochemical cycling. Crust communities in shrublands and woodlands of the eastern Sierra Nevada/western Great Basin ecotonal region are under-studied compared to other regions of the western United States. We constructed classification trees to identify important environmental predictors of soil crust distribution at the 1-meter scale within adjacent sagebrush shrublands and pinyon-juniper woodlands in the Walker River Basin. Environmental variables included vegetation, soils, and microtopography. We present results on the predictive power of these variables on crust occurrence collectively and on mosses and lichens specifically. This study provides a preliminary investigation of the habitat and distribution of soil crust organisms in the Walker Lake Basin and is a critical step in the identification of reference conditions, essential to informing monitoring, restoration, and conservation efforts.

Landscape-level changes in structure of the Russian forests projected for the 21st century

Nadja Tchebakova, Institute of Forest, Siberian Branch, Russian Academy of Sciences; Elena Parfenova, Institute of Forest, Siberian Branch, Russian Academy of Sciences; Amber Soja, National Institute of Aerospace (NIA); Allan Cantin, Canadian Forest Servi

Global simulations have demonstrated profound potential for GCM-projected climate change to affect the vegetation and forest composition across Russia by the end of the 21st century. We modeled progressions of potential vegetation cover and forest types in Russia in the warming climate . Large-scale bioclimatic models were developed to predict Russian zonal vegetation and forests (RuBCliM) from three bioclimatic indices: growing degree-days, 5 oC; negative degree-days and an annual moisture index. Additionally, the presence of continuous permafrost was explicitly included in the model as limiting the forests distribution. All simulations to predict vegetation change across Russia were run by coupling RuBCliM with bioclimatic indices and the permafrost distributions for the baseline and for the future 2020, 2050 and 2100 climates simulated by three global climate models (CGCM3.1, HadCM3 and IPSLCM4) and three climate change scenarios (A1B, A2 and B1). Under the warmer and drier projected future climate, about half of Russia would be suitable for the forest-steppe ecotone and grasslands rather than for forests. Water stress tolerant light-needled taiga (Pinus sylvestris and Larix spp.) would have an increased advantage over water-loving dark-needled taiga (Pinus sibirica, Abies sibirica, Picea obovata) in a new climate. The permafrost-tolerant L. dahurica taiga would remain the dominant forest type across the permafrost areas. An increase in severe fire weather would lead to increases in large, high-severity fires, especially at the southern forest border, which are expected to facilitate vegetation progression towards equilibrium with the climate.

Discussion

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Vegetables or Weeds, Meat or Pests? Negotiating ecosystem services and disservices in agricultural landscapes of Southeast Asia

Laura Vang Rasmussen, University of Copenhagen and University of Michigan; Ole Mertz, University of Copenhagen*

Most research on ecosystems focuses on provision of goods and services, and the concept of ecosystem disservices has emerged relatively recently. Disservices have of course been recognized throughout generations but have been dealt with in separate literatures, such as on crop pest management or protected area management. However, in order to account holistically for ecosystem functions, we propose to place services and disservices under a common assessment framework, allowing the estimation of net effects for human wellbeing. This is because many ecosystem functions can be perceived either as services or disservices depending on the context and few studies deal with this duality. Hence, in the present study we identify ecosystem disservices that turn into ecosystem services and vice versa and how this affects landscape management. We measured services and disservices in different agricultural landscapes of northern Laos using plot measurements, collection diaries, and interviews. We found, for example, that rodents cause crop yield losses of 10-20%. However, in communities with less intensive agriculture, rodents are mainly a food source as households collect more than 1 kg rodent meat per week. Weeds are another major cultivation constraint, but half of more than 100 species present in the plots are used for food, medicine, fodder etc. More intensive agriculture tends to switch perceptions of species from service to disservice. This balance is important to understand if global demand for conservation of species and landscapes is to be met in areas such as Laos with high conservation value and rapid land use change.

Panel Discussion

Facilitated by Eric Strauss, Loyola Marymount University, Los Angeles

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Signs of conservation: trajectory of occupancy status of tiger (Panthera tigris) and elephant (Elephas maximus) in the Terai Arc Landscape, India

Ramesh Krishnamurthy, Wildlife Institute of India; M. Naveen, Wildlife Institute of India; Subhodip Mukherjee, TERI University*

Terai Arc Landscape (TAL) is a globally important ecoregion and supports viable populations of keystone and flagship species such as tiger (Panthera tigris) and elephant (Elephas maximus). The landscape, spreading over 15000 km2, was surveyed during 2013/14 to document spatiotemporal change in the occupancy pattern and habitat quality as a measure of conservation management in the landscape. While the overall status of tiger occupancy (i.e. 12% of the landscape) has remained stable over ten years from 2003 to 2013, there were sharp declines in eight landscape units and increase in two landscape units, reflecting the nature of management inputs. In the case of elephant, the occupancy has reduced from 14.6% (Â± 27.7 SD) in 2003 to 10.2% (Â± 20.1 SD) in 2013. Although the management interventions have reduced the use of livestock (73.8% in 2003 to 60.0% in 2013) and domestic dogs (16.8% in 2003 to 11.1 in 2013), lopping of trees for firewood, fodder and other livelihood activities have significantly increased from 7.0% to 28%. The findings are striking in the backdrop of increased population size from 297 tigers (259 - 335 95% CI) in 2006 to 485 tigers (427 - 543 95% CI) in 2014. Reduction in occupied area with increase in population size indicates higher concentrations with skewed distribution, which functionally would tilt the ecological balance and will facilitate increased human-wildlife conflicts. Thus, the conservation management ought to place greater importance in the habitat quality than population size, which is prone to collapsing in unfavorable condition while improved

habitat quality would provide for recovery options in the long-term in the local as well as landscape context.

Role of private land in enhancing effectiveness and connectivity of biodiversity conservation: assessing stakeholders' attitude

Sristi Kamal, Institute of Environmental Sciences Jagiellonian University in Krakow; Malgorzata Grodzinska-Jurczak, Institute of Nature Conservation Polish Academy of Sciences, Institute of Environmental Sciences Jagiellonian University in Krakow*

Biodiversity conservation and landscape planning are closely interdependent as the need to assure connectivity of valuable areas requires effective landscape management. We highlight that private lands are crucial for both aspects. Contemporary global initiatives in private land conservation concentrate mostly on voluntary initiatives; however, private lands are also often part of regulatory conservation in protected areas as is the case in Poland. Regulatory form of private land conservation there has not focused on the social factors that influence its outcomes, which has led to human-nature conflicts. Hence, the goal of this research was to examine stakeholders' attitude toward biodiversity conservation on private lands, and assess the influence of socio-demographic, economic and certain external factors on landowners' attitude. The research was conducted across a national park, a landscape park and a Natura 2000 site in Poland. Q methodology, used to evaluate stakeholders' attitude, identified three predominant types of attitude that differ in their understanding and apprehension toward private land conservation. Subsequently, a questionnaire survey was conducted with 318 landowners to assess their attitudes and identify factors that influence this expressed attitude. Results from the survey revealed that intrinsic factors such as level of education and their conservation ethic along with external factors (e.g., type of protected area and level of restriction) had influence on expressed attitude, but differed from other factors identified to be influential for voluntary conservation. The findings lay the foundation for exploring the potential in landowners' characteristics to undertake voluntary actions and for making regulatory conservation more effective.

Environmental heterogeneity and the enhancement of pollination services in agricultural landscapes

Danilo Boscolo, University of SÃ£o Paulo - USP*

Pollination in tropical environments is a process mostly dependent on animals' abilities to move between flowering plants while foraging. In order to survive and effectively transfer pollen year round, pollinators must not only access flowers, but also several other resources dispersed within different environments. Landscape structure thus greatly affects the availability of pollinators and their accessibility to these resources and crops. The shape, size and spatial arrangement of natural environments, as well as the existence of different types of land use, can create varying degrees of landscape quality and permeability, interfering with the maintenance of pollination services. Efforts to improve the ability of pollinators to move through the landscape and ensure effective pollen transfer and the production of fruits and seeds is thus of paramount importance in agricultural landscapes. I will present recent research done mostly in Brazilian landscapes with intense agricultural influence. The results show that we can guarantee sustainable pollinator populations by creating landscapes that are sufficiently heterogeneous within pollinators foraging ranges. Pollinator-efficient agricultural landscapes must have crops interspersed by natural environments in several spatial scales, creating a variety of environments that can promote the conservation of local biodiversity while maintaining pollination services. This shall allow pollinators accessibility to all their required resources as well as to pollination-dependent crops. I argue that a wider view of landscapes as complex and diverse entities is needed to plan pollination sustainable agricultural landscapes.

Landscape Service Capability, Landscape Service Flow and Landscape Service Demand- the new framework of landscape service and its serving for landscape sustainability assessment

Xuening Fang ,State Key Laboratory of Earth Surface Processes and Resource Ecology, College of Resources and Technology, Beijing Normal University, China Wenwu Zhao ,State Key Laboratory of Earth Surface Processes and Resource Ecology, College of Resourc*

Producing methods to achieve sustainability development is a global challenge facing humanity in the 21st century. Landscape sustainability research plays an important role in sustainability science. Based on the theoretical framework of landscape sustainability science and the expansion of landscape service theoretical connotation, this article has proposed a conceptual framework of "landscape service capability-landscape service flow-landscape service demand" (LSCFD). Landscape service capability refers to the long-term potential of landscape in providing various types of valuable services to mankind. Landscape service flow refers to the transmission process of material, energy, information, conditions and effectiveness as provided by landscape to mankind, which happens either within or across the landscape. Landscape service demand is the societal dimension of the landscape services and refers to the types and volume of services that people need to satisfy their self-existence, livelihood, and development within the landscape region. The framework of LSCFD has covered the integration process of landscape service supply, transmission mechanism and achievement of human well-being to provide an operational framework for landscape sustainability studies. Hence, Based on the LSCFD framework of landscape services an assessment method has been developed for landscape sustainability. Landscape sustainability assessments can be performed by considering the following four areas: landscape service capability sustainability, landscape service flow sustainability, landscape service demand sustainability, and dynamic equilibrium relationships among the three. Under the new assessment framework of landscape sustainability, various types of landscape service capabilities, integrated services capabilities and the diversity and balance of landscape service demands should be evaluated. Besides, analyzing the supplying regions of landscape service flow, spatial orientation of beneficial population, transmission media, transmission mechanism and transmission limiting factors are essential in exploring dynamic equilibrium relationships among landscape service capability, flow and demand. Despite its advantage in landscape sustainability, the LSCFD framework needs to be tested with practical case studies for further validation and perfection. So in the end of the article, we take Beijing as a case study to explore how to perform landscape sustainability assessment with the LSCFD framework and its validation.

Biodiversity related indicators for ecosystem services in cultural landscapes

Thomas Wrbka, Univ. Vienna; Anna Schneidergruber, Univ. Vienna; Michael Kuttner, Univ.Vienna; Michael Glaser, Univ. Vienna;*

The concept of green infrastructure has been recently taken up by the European Commission for ensuring the provision of ecosystem services (ESS) and combating biodiversity loss. It aims at the supply of multiple ESS in a given landscape by planning, constructing and maintaining an interconnected system of seminatural landscape elements, embedded in a more intensively used landscape matrix. However, the effects of landscape multifunctionality on biodiversity have rarely been assessed. In this paper we use the transboundary World Heritage region of Ferto-Neusiedlersee as an example to investigate the relationship between plant diversity of different habitat types and their capacity of providing multiple ESS. ESS were mapped and classified according to the MAES-typology by using a two-step procedure: first, a capacity matrix for different broader habitat types was elaborated; second, this provision values were revised by additional information gained from field mapping to account for context specific differences of individual habitats. Data collection was carried out in stratified randomly selected habitat

patches which are a constituent part of regional green infrastructure and focussed on (a) systematically sampled vegetation relevees, (b) a suite of attributes (e.g. management intensity, structural heterogeneity, landscape context) for describing landscape functionality and ESS provision. Statistical data analysis is designed to reveal dependencies of plant diversity measures from the variety and quantity of ESS in individual patches, habitat mosaics and particular features of regional green infrastructure. Based on the respective results, a conceptual model for deriving biodiversity related indicators for ecosystem services in agricultural landscapes will be presented.

Effects of wildlife loss and land use change on rodent borne disease across multiple scales

Hillary Young, University of California Santa Barbara

Understanding the effects of biodiversity loss on zoonotic disease is of pressing importance to both conservation and public health. Here we use both large scale experimental manipulations and landscape scale observational data across large climatic gradients to examine the effect of land use change and large wildlife decline on a suite of rodent-borne zoonoses in East Africa. We find evidence for changes in both competence and abundance of hosts following disturbance, leading to pathogen specific effects of disturbance on disease. We seek to understand patterns underlying this variation that may allow for more predictive understanding of likely effects of disturbance on this disease.

Introduction: Interfaces between food chains, companies and local communities in local landscape management

Swaffield, Opdam, & Primdahl

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Distribution of remnant forests and tree communities in the 2011 tsunami-inundated area, Sendai Japan

Mizuki Tomita, Tokyo University of Information Sciences; Hiroshi Kanno, Tohoku Afforestation and Environmental Protection Co., Ltd.; Yoshihiko Hirabuki, Tohoku Gakuin University; Keitarou Hara, Tokyo University of Information Sciences*

Understanding how disturbance shapes distribution and tree composition of forests is of fundamental importance in landscape ecology. Huge tsunami, however, are infrequent, and our knowledge of their effect on forests is thus limited. This study aims to clarify distribution and tree composition of remnant forest patches, after the disturbance by the tsunami that followed the Great East Japan Earthquake of March 2011. In April of 2014, a study area (ca. 9 km x 3 km) was selected in an inundated area of Sendai that was hard hit by the tsunami. Remnant forests in the area were mapped using field surveys and aerial photographs. In each patch, the tree species that occurred in canopy layer and forest floor were recorded. The number of bud scars was also counted to determine the age of seedlings established after the tsunami. Almost all the large sized remnant patches originated from coastal forests. Tree compositions in the canopy layer differed among patches. In some patches, seedlings of various species other than those in the canopy layer were observed. These results indicate that differences in history, size and distance between the patches affect tree compositions after the tsunami. This study was partly supported by JSPS KAKENHI Grant numbers 24510332, 25830153 and the Environment Research and Technology Development Fund (1-1405) of the Ministry of the Environment, Japan.

Forests and people through eight millennia: how to bridge the sciences-humanities divide through quantifying and models

Peter Szabo, Institute of Botany ASCR; Petr Kunes, Institute of Botany ASCR and Charles University Prague; Jan Kolar, Institute of Botany ASCR; Radim Hedl, Institute of Botany ASCR; Jana Mullerova, Institute of Botany ASCR.

European forests have been influenced by humans for at least eight millennia. Although a number of disciplines have been dealing with reconstructing past interactions between humans and the wooded environment, the quantification of natural and anthropogenic changes across disciplines at larger spatial and temporal scales remains a challenge. In the LONGWOOD project, we combine palaeoecological, archaeological, historical and neoecological data and methods in Moravia (southeastern Czech Republic, ca. 27,000 km2) to study woodland dynamics in high resolution from the Neolithic until the 20th century. To bridge the gap between the sciences and humanities, we use a common GIS platform and create models based on the quantification of various data types. This presentation will focus on results from this project. In particular, we will present a Monte Carlo permutation based archaeological model that quantifies prehistoric human impact, which will be compared to regional landscape reconstruction models based on pollen data. We will also illustrate the possibilities of using an ecological model (MaxEnt) on archival sources to map traditional forest uses in the past half a millennium. The presentation will conclude with a discussion on historical trajectories and their consequences for vegetation change in the 20th and 21st centuries.

The history and future of LANDIS-II

Eric J. Gustafson, US Forest Service, Northern Research Station

LANDIS is a grid-cell forest landscape model (FLM) that simulates forest generative processes of establishment, growth, competition and degenerative processes of senescence and disturbances such as fire, wind, insect outbreaks and timber harvesting at landscape to regional scales. This introductory talk will describe the general features of LANDIS-II and explore how it differs from other models, including other variants of LANDIS. The talk will provide examples of the application of LANDIS-II to research and forest management questions to illustrate its strengths and limitations. The talk will conclude with some aspirations about the future of LANDIS-II to help meet the research and management challenges facing forests in this era of rapid global changes.

A Perspective Research on the Cooling Effect of Urban Green Space Areas with Trees in the City Scale

Fanhua KONG ,Haiwei YIN

Urban green spaces mitigate the urban heat island effect and provide cooler microclimates and have a role to play in mitigating the effects of urban climate change. In this paper, cool islands in Nanjing City, China were identified based on satellites image. The green space characteristics of urban cool islands were analyzed by using correlation analyses at multiple scales. The results indicate that 1)the percent of forest vegetation has a strong relationship with the relatively cooling degree (RCD) - and at a fixed scale, 240mÃ—240m window size, a 10% increase in forest vegetation resulted in about 0.83â„ƒdecrease in surface temperature. 2) The correlation analysis between landscape pattern metrics of forest vegetation with RCD also confirmed that given a fixed amount of forest vegetation, fragmented green spaces are also preferable for effective cooling; 3) The spatial pattern of the urban cool islands was strongly correlated with the green space pattern, and, specially, a mainland-island green space spatial pattern was an efficient means of enhancing the cooling effects. Multiple linear regression analysis showed that the intensity of the cooling effect was impacted by the forest vegetation area and its spatial arrangements, as well as the composition of the cooling island and its neighbor environment. The

analysis will help to explicitly predict the effects of particular amounts of and the spatial arrangement of green space and accordingly help to city managers and planner to mitigate predicted climate change.

Development and application of Landis' PnET-Succession extension

Arjan de Bruijn Eric Gustafson Brian Miranda Brian Sturtevant Douglass Jacobs

Researchers have previously linked tree physiology with disturbance and regeneration processes through coupling of the PnET tree physiology model with the spatial forest landscape model LANDIS in a serial application. To strengthen the links between rapidly changing fundamental drivers (e.g., climate, CO2, ozone) and forest dynamics, we incorporated PnET functions into LANDIS-II and used it to predict succession patterns in eastern forests, with emphasis on the fate of a particular species (American chestnut) that is a candidate for reintroduction after the devastating blight of the early 1900s. We used two introduction scenarios: 1. Passive, which assumes that chestnut migrates into the area from plantations on abandoned coal mines east of the study area, and 2. Active, where chestnut is planted after harvest of oaks. These introduction scenarios were confronted with various factors such as novel insect pests, management regimes, and climate change. Our results show an overall reduction of aboveground biomass (and carbon) of ~20%, primarily due to pests. The reduction of biomass occurred mainly in oak species. Various species of pine tend to benefit from the reductions of oak. Due to a limited migration distance of chestnut seeds that depend on rodents in the passive introduction scenario, chestnut migrates into the area at a rate of ~30 m per decade, which results in very limited presence on the landscape. Chestnut exceeds the total landscape biomass of about half the species in the active introduction scenario, but its effect on carbon sequestration at the landscape scale is modest.

Effects of Coffee Agroecosystem Management on the Population Structure and Dispersal of a Tropical Forest Rodent (Heteromys desmarestianus)

Beatriz Otero Jimenez, Priscilla Tucker, John Vandermeer - Department of Ecology and Evolutionary Biology University of Michigan-Ann Arbor*

Land-use changes for agricultural production represent the majority of anthropogenic land transformations. The associated loss and fragmentation of natural habitat is considered the main driver of population declines and loss of biodiversity. Understanding the effect of agricultural matrix composition on dispersal of species is essential for the development of successful conservation plans. Our study uses genetic information to address dispersal in fragmented landscapes. We evaluate the genetic structure of a common forest rodent (Heteromys desmarestianus) in forest fragments surrounded by a coffee agricultural matrix in southern Mexico. We sampled 168 individuals from one forest fragment and 3 coffee farms representing varying management intensity within an area of 10 km2. Using microsatellite markers, we assessed the population structure of H. desmarestianus and the effect of management intensity on this genetic structure. We implemented the Bayesian clustering Geneland. Five genetic clusters were found. One of these clusters included individuals from the forest fragment, low intensity coffee farm and individuals from medium and high intensity coffee farms adjacent to the forest fragment. A second cluster was composed of all other individuals from the medium intensity coffee farm. The individuals from the high intensity farm were assigned to the remaining three clusters, for many individuals we identified mixed cluster membership (i.e., similar probabilities of belonging to different clusters). These findings suggest that the coffee agricultural matrix may be permeable enough to facilitate H. desmarestianus dispersal and gene flow, but that the degree of permeability varies with management intensity.

From trees to buds - the explosive growth of marijuana agriculture in Northern California.

Van Butsic, University of California Berkeley

Medical marijuana has become one of the largest agricultural sectors in California. Yet little is known about the total amount, value, location, and environmental impacts of medical marijuana farming. This is worrisome because just like other agricultural producers medical marijuana growers use large amounts of water and potentially use fertilizers. With little knowledge of the spatial location and extent of these farms it is difficult to evaluate the impact of medical marijuana on the landscape. Here, we map medical marijuana grows in Humboldt County CA, using digital imagery and heads up digitizing. These maps provide the first systematic information the number, size and location of grows. We find extensive marijuana cultivation in our study area, with over 1000 outdoor gardens and 1000 greenhouses located in our county. Many of these grows are located outside of the official road networks indicating that new roads were likely carved through the forests to give access to the grows. In addition, most grows are not situated in areas without groundwater, indicating that irrigation likely comes from streams, many of which are home to endangered Coho species. Overall, our results indicate the potential for medical marijuana to transform the landscape.

Linking soundscape to forest structure in a human-dominated tropical dry forest in southern Madagascar

Anne C. Axel, Marshall University; Lyndsay Rankin, Northern Illinois University*

A great deal of soundscape ecology research has focused on links between sound metrics and species diversity. One assumption of these studies is that soundscape reflects eco-condition; that is-we expect soundscapes to vary by habitat and condition with "high-quality" habitat having the highest soundscape metric levels. Yet, there are relatively few studies relating soundscape metrics to habitat structure or condition. Here we describe a year-long acoustic data set (with replicates) in a highly seasonal tropical dry forest landscape in southern Madagascar with two distinct (but spatially proximal) habitat types and three distinct grazing conditions. Multiple vegetation parameters in both the canopy and understory were collected to describe vegetation condition and forest type. The soundscape metric, bioacoustics index, was related to forest vegetation parameters. Measures of soundscape largely reflected forest condition, especially in deciduous dry forest. However, in the case of moderate grazing in gallery (riparian) forests, bioacoustics index measures were higher than in ungrazed gallery. Seasonal differences in this soundscape suggest researchers should consider the potential limitations of snapshot seasonal acoustic data and should also make an effort to collect acoustic information over multiple seasons in highly seasonal environments.

Future directions: Research priorities for landscape management of ecosystem services and biodiversity

Elena M Bennett, McGill University; Wolfgang Cramer, Institut Mediterraneen de Biodiversite et d'Ecologie Marine et Continentale (IMBE)

Ecosystem services have become a mainstream concept for the expression of values assigned by people to various functions of ecosystems. The introduction of the concept has initiated a vast amount of research, leading to considerable advances in our understanding of multiple services across landscapes. However, progress in using this knowledge for sustainable resource use across landscapes remains insufficient. Here, we will draw on earlier presentations in the session to synthesize the state of the art in landscape research on multiple ecosystem services. We suggest broadening the scope of research to answer three key questions that we believe will improve incorporation of ecosystem service research into decision-making about landscape management: (i) how are ecosystem services co-produced by

social-ecological systems, (ii) who benefits from the provision of ecosystem services, and (iii) what are the best practices for the governance of ecosystem services? We will present the rationale behind prioritizing these key questions and their related scientific challenges, focusing on the landscape ecology of co-production of social-ecological systems.

Socioeconomic spatial inequalities in the Metropolitan Area of Santiago,Chile: A multidimensional approach

Ignacio Fernandez, Arizona State University - School of Sustainability

Socioeconomic inequalities present significant challenges to the sustainability of many cities in Latin-America. Although inequalities in these cities are usually coupled with a strikingly uneven spatial distribution of human development assets, the spatial component of inequalities is seldom addressed, hiding key information from policy-makers. To reduce this information gap, in this work I quantified the temporal trends (1992-2011) of spatial socioeconomic inequalities in the Metropolitan Area of Santiago, Chile, and then evaluated the potential effects of spatially correlated inequalities through a multidimensional human development indicator. I accomplished this by using official available survey data for Santiago's 34 municipalities to calculate five standardized development indicators (Income, Education, Health, Democracy, Housing) for years 1992, 2003, 2011. These data were mapped on vector layers, and used to calculate a spatial inequality and a segregation index for each development indicator. Overlaying these indicators spatially I then created a multidimensional development indicator. Resulting maps and spatial indices were qualitatively and quantitatively analyzed to evaluate the temporal trends of inequalities and segregation at the city level. Results show that whereas four out five indicators present a reduction of spatial inequalities, the multidimensional approach reflects a significant increase in inequalities for the analyzed period. The segregation index shows a similar trend, with a reduction in the spatial clustering for three out five indicators, but an increase of segregation in the multidimensional indicator. Results from this work highlight the importance to address inequalities problems from a spatial perspective.

Introduction to Symposium

Ulrich Walz, Leibniz Institute of Ecological Urban and Regional Development; Christian Stein, Leibniz Institute of Ecological Urban and Regional Development*

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Knowledge Speaks, but Wisdom Listens: How Do We Plan Landscape Wisely?

Wei-Ning Xiang, University of North Carolina at Charlotte, USA

Wisdom has been traditionally the topic in philosophy and religion since the dawning of human civilization. Recently, however, there is an emerging wave of interests in wisdom research from the realms of social sciences and planning: in the face of unprecedented challenges toward sustainability, people, recognizing limitations in science and technology, seeks something beyond scientific knowledge for enlightenment and solutions. Within this context, in landscape planning and design, where wisdom guided and nature-inspired practice has a long tradition, emerges a renewed interest in ecological wisdom. This is evidenced not only by an increasing number of pertaining scholarly publications, but also by a wide range of planning and design cases from around the world in which ecological wisdom principles are employed to coping with real world problems. Underlying these instances is a strategy that looks out further, temporally, geographically, and philosophically (East, West, ancient, contemporaryâ€¦) for ecological wisdom, and to use it selectively and mindfully, in conjunction with

principles and strategies of economic, political, social, and cultural relevance, to inform the practice of landscape planning and design. In this presentation, drawing upon recent research findings from a transdisciplinary group of international scholars, I examine evidence of this emerging interest in ecological wisdom; discuss its relevance to landscape research, planning, and design; and propose a research agenda.

Biocultural landscape diversity: global approaches and local applications

Gloria Pungetti, CCLP, University of Cambridge, UK

Biocultural landscape diversity studies have recently been applied to landscape ecology worldwide. This research outlines the results of such studies, from global approaches to the involvement of local communities with their cultural and sacred landscapes, their traditional knowledge and contemporary practices. Cutting-edge methods to investigate the value, character and services of biocultural landscapes across scales and borders are illustrated. Mountainous, rural, agricultural, urban, coastal, island and marine ecosystems are considered for the conservation and development of biocultural landscapes especially in Europe and Asia. Initiatives have been developed to support the above methods and promote synergies between ongoing activities on biocultural landscape and seascape diversity worldwide. Such synergies have been actively implemented through scientific networking, research cooperation and community involvement. Among these initiatives CCLP-EUCEL, European Culture expressed in Landscapes, provides examples of know-how dissemination and raising awareness, in order to inform landscape planning, management and policy for the future development of biocultural landscapes. EUCALAND, ESLAND and ECSLAND Projects on agricultural, island and scared landscapes in Europe have applied the EUCEL approach in the last decade. Among the research communities, the Working Group on Biocultural Landscapes has been set up in 2014 within IALE World. The founders, after a first meeting at the IALE World Congress in Beijing in 2011, are gathering together again in the Symposium 'Biocultural Landscape Diversity: building bridges from global approaches to local applications' at this IALE World Congress 2015 to illustrate and discuss their research, and to plan future activities with all IALE members interested.

Comparing approaches and outputs from an enhanced niche model (TreeAtlas/DISTRIB) to Landis Pro for forest managers in central and northeastern United States

Louis R. Iverson, USDA Forest Service, Northern Research Station, Delaware OH; Anantha Prasad, USDA Forest Service, Northern Research Station, Delaware OH; Stephen Matthews, Ohio State University and USDA Forest Service, Northern Research Station, Delawa*

Landis and TreeAtlas have been used concurrently on several climate change assessments across the north and central portions of the eastern US, as supported by the Northern Institute of Climate Science (NIACS). This side-by-side comparison of a dynamic forest landscape model (Landis) with an enhanced niche model (TreeAtlas/DISTRIB) has proven to yield better perspectives for managers on potential future forest outcomes, as opposed to single approaches. TreeAtlas uses a RandomForest statistical approach with forest inventory and environmental variables enhanced with Modification Factors which factor in literature-based assessments on 12 disturbance and 9 biological traits of the species. Landis Pro incorporates several environmental inputs as well as outputs from LINKAGES II, which derives species establishment probabilities and maximum biomass by simulating growth of individual species from bare ground, to simulate succession under various scenarios of climate change and management for the primary species in the region. In this presentation, we compare Landis Pro and TreeAtlas approaches and outcomes for a portion of the Central and Northeastern US. Each approach provides advantages, along with disadvantages, in providing realistic outcomes for managers. TreeAtlas provides a coarse-

grain output of suitable habitat (not actual simulation of what live trees will be present at a given time) for three 30-year periods in this century. It can provide information on any species with adequate forest inventory presence. Landis provides fine-grained, succession-linked outputs tied to simulated disturbances, but for fewer species. We have found agreement in interpretation for many of the primary species in the study areas.

Land cover, climate, and demographic characteristics associated with counties reporting human West Nile virus disease in the United States, 2004-2013

Micah B. Hahn1,2, Andrew J. Monaghan1, Roger S. Nasci2, Marc Fischer2 1National Center for Atmospheric Research, Boulder, CO; 2Division of Vector-Borne Diseases, Centers for Disease Control and Prevention, Fort Collins, CO

West Nile virus (WNV) is the leading cause of mosquito-borne disease in the U.S. Approximately half of counties (N=1476, 48%) in the contiguous U.S. have reported a human WNV case between 2004-2013. We compared land cover, climate, and demographic characteristics of counties that reported at least one WNV neuroinvasive disease case to the CDC between 2004-2013 with counties that have not using logistic regression to control for the population of the county. We used land cover data from the National Land Cover Database, meteorological data from the North American Land Data Assimilation System, and demographic data from the U.S. Census. Counties with a lower percentage of developed open space (vegetation like yards, parks, golf courses) and a higher percentage of high intensity urban development, pasture, grasslands, and crop cover were more likely to have reported a WNV case. Counties with less annual average precipitation and more annual growing degree days over 14Â°C were more likely to have reported a case. Counties with a lower percentage of the population under the age of 60 were also more likely to have reported a WNV case. Our results suggest that the land cover and demographics in counties that have reported human WNV in the past decade differ from counties that have not reported cases. These risk factors for WNV transmission may be used to make long-term projections for new high risk areas undergoing social and ecological change.

New approaches to inform the connection and protection of the last vast places in the western U.S.

Brett G. Dickson, Conservation Science Partners, Inc.; Luke J. Zachmann, Conservation Science Partners, Inc.; Christine M. Albano, Conservation Science Partners, Inc. and John Muir Institute of the Environment, University of California, Davis*

In the context of climate and other environmental changes, extensive areas of public land, including those administered by the Bureau of Land Management (BLM), present substantial opportunities to protect well-connected areas of conservation concern. For 12 western states, including Alaska, we used a novel multiple-criteria analysis to map contiguous areas of roadless BLM land that possessed important ecological indicators of high biodiversity, resilience to climate change, and connectivity. We leveraged new and existing spatial datasets to implement a systematic and statistically robust analysis of eight key indicators at several spatial scales, and to identify areas with relatively high conservation value across 41-million hectares of roadless BLM land. We identified 13-million hectares of land with relatively high conservation value mostly located in Alaska, Utah, Colorado, Arizona, Oregon, and Nevada. The highest value lands exhibited greater species richness, vegetation community diversity, topographic complexity, and surface water availability than existing BLM protected areas. As measured by our indicators, BLM lands encompass vast areas of ecological importance relative to other lands managed by the National Park Service and U.S. Forest Service, and serve as critical linkages between already protected areas across the public domain in the West. A secondary analysis based on circuit theory indicated high likelihood of ecological connectivity from southern Nevada through Utah and into

western Colorado. Connectivity was facilitated by a network of existing protected areas, and across multiple jurisdictions. Our results provide a timely decision-making tool as the BLM and other agencies engage in large landscape analyses and planning efforts.

Land Use Change and its Impacts on Biodiversity, Agricultural Productivity and Water Balance in the Sta.Rosa-Silang subwaterhed, Philippines

Damasa M. Macandog, University of the Philippines Los Banos; Dalton Erick S. Baltazar, University of the Philippines Los Banos; Maria Francesca O. Tan, University of the Philippines Los Banos; Maria Noriza Q. Herrera, University of the Philippines Los Ba*

The Silang-Santa Rosa Subwatershed has undergone extensive and rapid land use changes in the past two decades brought about by rapid urbanization and industrialization. Consequently, ecological balance and functions in the subwatershed have been altered. Significant changes have affected plant and wildlife biodiversity, the sustainability of agricultural and agroforestry systems and water balance. Participatory Rapid Rural Appraisal methodologies were conducted to further understand the patterns, drivers and impacts of land use change in the subwatershed. A biophysical survey of agricultural and agroforestry systems and farmer interviews were conducted to determine farming practices and assess their environmental impacts. Plant and wildlife diversity were surveyed in various land uses including grassland, riparian forest patch, and multi-storey agroforestry. The KINEROS water balance model was parameterized to estimate runoff and sediment yield in the subwatershed. The negative impacts of land use conversion include not only the decline in agricultural production and biodiversity but also increased soil erosion and surface run-off. The area supports a limited number of mammal and bird species, all of which can tolerate some degree of disturbances. The KINEROS model was used to simulate runoff and sediment yield of different land cover scenarios. Rehabilitation strategies and other measures to address the environmental degradation in Laguna Lake watershed were developed and recommended to policy makers and local government units in the area. Recommended strategies and measures focus on sustainable natural resource management to attain food security in the region and improve the state of the environment and quality of life.

Historical changes of distribution patterns of tree in paddy field landscapes in northeast Thailand

Ha T. Pham, United Graduate School of Agricultural Science - Gifu University; Shuichi Miyagawa, Graduate School of Applied Biological Science - Gifu University*

The crisis of biodiversity decline due to habitat loss and fragmentation has been going on for decades. Although harbor a great portion of worldâ€™s diversity and sources of humanâ€™s benefits, researches on effect of land use change on diversity in traditional managed landscapes are still lacking. Using remote sensing analysis, we examined the distribution patterns of tree in three traditional paddy field landscapes, each with different history of land use, in rural areas of northeast Thailand. In each 1km-radius study site circle, land use land cover, tree density and their micro habitat were recorded in three different time series: present, 24 and 40 years ago. We found that the oldest landscape, with 1000 years of cultivating history, has the highest present total tree density of 9.12 haâˆ’1, but shows a constantly declining trend from 40 years ago. On the contrary, total tree density of the other two 100 and 300 year-old-landscape started increasing since 24 and 40 years ago, respectively; results in present total tree density of 7.09 and 6.85 haâˆ’1, correspondingly. No relationship was found between landscape structure and distribution pattern of trees, present or past. Our results suggest that diversity in managed landscape may not simply be influenced by history or changes of land use like in natural or semi-natural ones. Instead, human preference is likely a decisive factor, as the variation range of total

tree density keep narrowing. Further investigation on similar landscapes should be conducted, to find out which mechanism causing the present day diversity.

Participatory Land Use Planning in Cambodia

KHUN BUNNATH, Technical Deputy Team Leader/ Forestry and Biodiversity Specialist of Biodiversity Conservation Corridors Project in Cambodia.

The Land Law classifies the various types of property within the Kingdom of Cambodia and the ownership rights that are available with the different classifications. At the same time, the Forestry Law creates a classification scheme for the forest lands in the Kingdom. There continues to be some confusion as to how these two classification schemes work, and how they interact with one another. This initial overview tries to provide a concise and simple explanation of how property and forest land are classified under the two pieces of legislation, and points out where there may be areas of confusion. The terms used in this overview are the same as those used in the current unofficial English translations of the Land Law and the Forestry Law. Problems with the terminology and definitions will be explored in the weaknesses analysis. Participatory Land Use Planning (PLUP) was initiated by the government and NGOs in year 2002 as tool to identify all the land use pattern in Cambodia, especially at the rural areas. That's a bottom up planning approach which was encouraged all relevant people and stakeholders participate in the planning and development processes. This poster presentation will indicating the major legal steps of the PLUP process, the gaps and weakness and the opportunity to scaling up within the Cambodia context.

Landscape Conservation Design: Conserving Sustainable Landscapes by Design

Rob Campellone, US Fish and Wildlife Service

Conserving sustainable landscapes in the 21st century is a significant challenge that requires a fundamental shift in thinking and action, addressing both social and ecological systems. "Landscape conservation design" is an integrated, collaborative, and holistic landscape-scale, science-based process and product that seeks to enhance the efficiency and effectiveness of stakeholders' missions, mandates, and goals while ensuring landscape sustainability for current and future generations of Americans. It involves intentional human changes to landscape patterns to sustainably provide ecosystem services that meet societal needs and respect societal values. This paradigm is innately interdisciplinary and partner-driven, involving diverse stakeholders, who plan, identify and implement strategies across the landscape to achieve diverse goals. This presentation will provide an overview of the policy that supports a landscape conservation design approach, as well as an overview of the process itself.

Urban Watershed Restoration Projects and Property Values

Noelwah Netusil, Reed College; Maya Jarrad, Reed College*

We use a repeat sale hedonic hybrid model to estimate the value to homeowners of urban and rural riparian restoration projects implemented by the City of Portland's Bureau of Environmental Services and other watershed partners. Restoration projects are largely driven by aquatic habitat enhancement and flood risk reduction. The study uses single-family properties that transact at least twice between 1988 and 2011 and are located within 5 km of the main branch and tributaries of Johnson Creek, a prominent waterway with green space and recreation opportunities in the Portland metropolitan area. Johnson Creek flows 26 miles through agricultural, industrial, and residential land. The watershed traverses six jurisdictions. The application of a GIS allows us to relate sale data with the restoration

project locations and a variety of environmental controls. Restoration projects used in the analysis were started in the years 1994 through 2010, are spatially distributed throughout the study area, and range in size from less than an acre to over a hundred acres.

2. From operational to strategic planning - bridging temporal scales. Discussion "Best practices" or recommendable strategies for including temporal fluctuations in the ES provision and demand in pla
(Moderation Christian Albert; Discussant: Roy-Haynes Young, University of Nottingham)

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Assessing the effects of landscape pattern change on water quality in in the process of rapid urbanization in Shenzhen, China
Zhenhuan Liu Department of Land Resources and Environment Studies, School of Geography and Planning, Sun Yat-Sen University, Guangzhou, China

As an important part of watershed management, urbanization caused the changes of urban land use and land cover has become one of the key issues involved in the deterioration of water quality. Human activities have transformed the landscapes in Shenzhen where damaged the river systems need to be restored and better managed for urban environmental sustainability. Toward this end, the study quantified the landscape pattern of Shenzhen between 1990 and 2010 based on remote sensing data and field measurements. Then, we employed the spatial statistic methods to regress the landscape pattern index with water quality variables during this stage. The results show that water quality in Shenzhen differed among watershed and also changed significantly during the recent decades. These changes in space and time indicate a trend of restoration in water quality. However, Landscape pattern had major impacts on the processes of water quality change. In particular, impervious surface area in watershed and number of patches ware recognized as the dominant variables influencing the water quality. The ISA below 36.9 % in urbanization watersheds can be enable effective urban watershed management.

Implications of projected climate change for relative roles of disturbance, climate and site drivers on stand level dynamics across a plot network of the perhumid coastal temperate rainforest.
Sari C. Saunders, BC Ministry of Forests, Lands, and Natural Resource Operations; Heather Klassen, BC Ministry of Forests Lands, and Natural Resource Operations; Brian Buma, University of Alaska Southeast; Paul E. Hennon, USDA Forest Service, Pacific Nort

Coastal temperate rainforests of North America span broad gradients of climate and topography from southern Oregon (OR) and Washington (WA) to southeast Alaska (AK), including coastal British Columbia (BC). The range in temperature, moisture, continentality, and historical biogeography influence current distributions of forest species and ecosystems, and their primary disturbance drivers. We compared stand composition and vertical and horizontal spatial structure of old growth mapped plots across BC and AK over a 15 year period. Although some measures of old growth structure, e.g., numbers of snags and large live stems, were similar between our BC stands and data published for the US Pacific Northwest and Alaska, other measures of productivity and dynamics, e.g., size and decay class of downed wood, differed consistent with expectations of climatic influences on productivity and decomposition. Within BC, spatial structure appeared driven by an interaction of stand-level disturbance that varied in intensity and frequency across latitudes, with finer scale gap dynamics. We use this existing comparative plot network and analysis to consider the implications of projected changes in

climate and disturbance regimes for stand composition, dynamics and spatial structure across this latitude.

Transitions in European Land-Management Regimes between 1800 and 2010

Martin Rudbeck Jepsen, University of Copenhagen, Section for Geography, Institute of Geosciences and Natural Resource Management; Tobias Kuemmerle, Humboldt University, Berlin; Daniel Muller, Humboldt University, Berlin; Karlheinz Erb, Institute for Socia

Land use is a cornerstone of human civilization, but also intrinsically linked to many global sustainability challenges. Understanding the underlying technological, institutional, and economic drivers of land-use change, and how they play out in different environmental, socio-economic and cultural contexts, is therefore important for identifying effective policies to successfully address these challenges. In this regard, much can be learned from studying past land-use change. We examined the evolution of European land management over the past 200 years with the aim of identifying (1) key episodes of changes in land management, and (2) their underlying technological, institutional and economic drivers. To do so, we generated narratives elaborating on drivers of land use-change at the country level for 28 countries in Europe. We then qualitatively grouped drivers into land-management regimes, and compared changes in management regimes across Europe. Our results allowed discerning seven land-management regimes, and highlighted marked heterogeneity regarding the types of management regimes occurring in a particular country, the timing and prevalence of regimes, and the settings that explain observed bifurcations. However, we also found strong similarities in the timing of certain land-management regime shifts, often in relation to institutional reforms. Overall, our results demonstrate that land-system changes should not be conceived as unidirectional processes following predefined trajectories, but rather as path-dependent processes that may be affected by various drivers, including sudden events, which influence land management

Impacts of an urbanization gradient on plant communities: a case study along riparian corridors in Strasbourg, France

Eugenie Schwoertzig, LIVE-UDS -CNRS UMR 7362 / Strasbourg Eurometropole ; Nicolas Poulin, CeStatS / IRMA-UDS-CNRS UMR 7501 ; MichÃ¨le TremoliÃ¨res, LIVE-UDS-CNRS UMR 7362*

In an urban context, riparian corridors are a widespread and popular tool to mitigate landscape transformation and fragmentation and to maintain connections between riparian ecosystems. Nevertheless, riparian corridors are also increasingly threatened by urban expansion. It is then difficult to estimate how many urban riparian corridors issues, like connection to functional communities, conservation of habitat or movement of plants, are still guaranteed. This study focused on two rural-to-urban riparian corridors in Strasbourg (Eastern France). Three levels of urbanization based on landscape composition were detected and used to assess the ecological impacts of urbanization on riparian communities' distribution. The environmental effects such as the distance to the nearest natural area and/or the modification of soil characteristics created a novel anthropogenic habitat that determines species presence and plant functional type. However plant species distribution also depended on the surrounding pressures and land cover. By analyzing the landscape composition and configuration within 500 meters of the study sites, we showed that matrix transformation and fragmentation resulted in a net loss of specific species of riparian area and a gain of cosmopolitan species. Impacts of urbanization on riparian communities were therefore simultaneously the consequences of both landscape patterns and habitat modification.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Implication of LiDAR returns and data reduction in estimation of urban forest biomass at regional extents

Kunwar K. Singh, Northern Plant Ecology Lab, Department of Biology, University of Saskatchewan Saskatoon, Canada; John B. Vogler, Center for Geospatial Analytics, Department of Forestry and Environmental Resources, North Carolina State University.

Assessment of forest aboveground biomass and carbon stock is increasingly dependent on LiDAR data. However, higher LiDAR point densities and return numbers pose challenges in procuring and processing voluminous LiDAR data for large-area assessments. Data reduction techniques are often used to overcome these challenges but rarely LiDAR returns are analyzed to estimate forest biomass. We examined the effects of LiDAR returns and data reduction on estimates of forest biomass in the Charlotte Metropolitan Region of North Carolina, USA. We extracted structural metrics using all returns, first returns, and first return of each laser pulse from original LiDAR data and from seven point density reduction samples (80%, 60%, 40%, 20%, 10%, 5%, and 1%). We used linear regression to establish statistical relationships between field-measured biomass and LiDAR-derived predictor variables PVs for each return and point density combination. We selected non-collinear PVs using the VIF, and identified the best set of explanatory PVs based on the lowest AIC value. Using adjusted-R2, the explained variance of biomass models was consistent across all combinations of LiDAR returns and reduced point densities. While the greatest difference between 100% and 1% point densities was 13.3% for the first returns, all three return types performed consistently across all point densities. In addition, the variance of predicted biomass estimates was similar to field measured biomass across the spectrum of models. Our evaluation suggests that for regional-scale assessments of forest biomass, the use of first returns data normalized by topography is an effective alternative to point density reduction that does not compromise the accuracy of biomass estimates.

Magnitude and spatial structure of hillslope soil erosion on Mt. Elgon in Uganda

Yazidhi Bamutaze, Makerere University, Kampala, Uganda Wilber Wejuli, MONUSCO, GOMA, DRC*

Soil erosion remains a fundamental geomorphological challenge with ecological and productivity implications in tropical mountain systems. Despite the serious threat, limited studies have addressed the magnitude and spatial structure of soil in mountain ecosystems. In this study, we used a combination of experimental measurements and geostatistical techniques to assess the magnitude and spatial structure of soil erosion on a hillslope collapsed to three segments i.e. footslope, backslope and upper slope. Twelve runoff plots (150m2) representing the three hillslope segments and four replications were installed on cropped sites to quantify soil erosion from varied rainfall depth events. Extrapolated to 61 plots (150m2) based on factorial similarity, the measured data was used to geostatistically model the spatial structure of soil erosion also as a function of rainfall event size quartiles. Both Ordinary Kriging (OK) and Kriging with External drift (KED) were used for spatial interpolation. The magnitude of soil erosion was 36 + 29t/ha/yr and was highly variable; CV=83%. Soil loss varied from 5t/ha/yr to 96t/ha/yr. The greatest soil loss (44t/ha/yr) and lowest soil loss (29t/ha/yr) occurred in the lower and middle segments respectively. The hillslope soil erosion spatial structure varied as a function of rainfall depth size.

Session Wrap Up/Conclusions/ Roundtable

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40-minute round table discussion on synergies and common approaches and challenges of modelling the implications of land use change for landscape function and ecosystem services, and the usefulness of this work for landscape management

Landscape Degradation processes in Europe and Central Asia

Prof. Dr. Burghard Meyer, Institute fo Geography, Leipzig University

Landscape degradation in Central and East Europe as well as in Central Asia is significantly influenced by the former arable agricultural system originated in the Soviet styled farm organisation, which modified diverse landscapes into uniform mono-functional production landscapes by neglecting the sustainability and the carrying capacities of the former cultural landscapes or natural near steppe environments. The investigation gives examples about typical landscape degradation processes discussing (1) large scale landscape degradation problems originated by water distribution mismanagement in the context of Syrdarya/Amurdarya river catchments in Central Asia resulting the Aral lake crisis; (2) the temporal changes of landscape structures and related changes in landscape functioning and ecosystem services based on a complex landscape analysis by using examples of East German arable landscapes and (3) on the basis of modelling results of climate change scenarios by impact analysis on expected changes in wind and water erosion as well as expected changes in biodiversity for Hungarian landscapes. The analysis gives an integrative insight on major driving forces resulted by landscape management and planning including the scenario perspective about future management implications as well as on the analysis of the causal networks resulting land use change and landscape dynamics.

How many people can global drylands supportï¼Ÿ Perspective from water stress index dynamics under climate change and urbanization

Chunyang He, Zhifeng Liu - Center for Human-Environment System Sustainability (CHESS), State Key Laboratory of Earth Surface Processes and Resource Ecology (ESPRE), Beijing Normal University, China

Global drylands have become the key areas affecting sustainable development around the world in consideration of their scarce ecosystem services, severe land degradation, high poverty rates, intensive extraction activities, and rapid urbanization. However, the water carrying capacity of global drylands under the double stresses of urbanization and climate change remain largely unknown today. Our objective was to clarify the water carrying capacity in global drylands using the water stress index (WSI). We examined WSI dynamics from 1990 to 2030 at global, national and basin scale. We found that the WSI of global drylands increased from 0.57 in 1990 to 0.67 in 2010 and 0.86 in 2030. Particularly, the WSI will have an obvious increase in the drylands of China, the Central and Western Asia, the Northern Africa, and North America from 2010 to 2030. Our findings suggest that global drylands are approaching overpopulation with the complex stresses of fast urbanization and climate change. Effective measures need to be implemented to facilitate the sustainable development of the global drylands. Particularly, more concerned needed to be given to the drylands of Indus River Basin in the Central Asia and the Yellow River Basin in China due to their heavy water shortage and high overpopulation.

Mapping the emergent structure of biophysical dispersal barriers and the consequences for gene flow

Eric A Treml, University of Melbourne; Cynthia Riginos, The University of Queensland*

The geography of dispersal barriers should influence patterns in phylogeography and population genetics, species diversity, isolation and endemism, and metapopulation persistence, yet the importance of the biophysical processes associated with permeable barriers is not well-understood. Here, we evaluated potential dispersal barriers across the Indo-West Pacific and developed spatially-

explicit hypotheses regarding the location of barriers and their capacity to filter taxa. A biophysical dispersal model was used to quantify over 800,000 dispersal kernels by simulating 99 model taxa. Spatial landscape analysis was used to map emergent patterns of potential multi-species population connectivity and predict geographic locations and strength of concordant dispersal barriers across the seascape. Although individual taxa varied in their predicted fine-scale population connectivity, there was consistency in the location of dispersal barriers. Across all trait combinations, reproductive output, reproductive strategy, and the length of the larval dispersal phase determined the strength of barriers across the seascape. More than 80% of the previously described marine boundaries in the region were predicted to restrict the dispersal of at least 10% of the simulated taxa. This approach may contribute to the development of an accurate bioregionalisation and robust conservation prioritization across the Indo-West Pacific, and fill gaps in our understanding of the biogeography.

Diversity and species distribution modelling of sea stars along the Pacific Northwest continental shelf

Lenaig G. Hemery, Oregon State University - Hatfield Marine Science Center; Chris Romsos, Oregon State University - College of Earth Ocean and Atmospheric Sciences; Scott Marion, Oregon Department of Fisheries and Wildlife, Alexander Kurapov, Oregon Stat*

About fifty-five species of sea stars live on the Pacific Northwest continental shelf. Approximately twenty intertidal and subtidal species suffered from the sea star wasting disease (SSWD) that occurred during months since June 2013 from Alaska to Baja California. This disease drastically altered population densities and potentially species distributions in most of the intertidal areas. However, sea stars' exact distributions and ecological requirements are unknown, particularly in the subtidal area, and a better knowledge could help identify populations that are at risk due to susceptibility related to environmental stress. Relating occurrence data from different sources (museum catalogs, trawl surveys, underwater video surveys) recorded before June 2013 with abiotic parameters, we used ecological niche and species distribution modeling to estimate patterns of distribution and determine ecological requirements of eleven sea star species from Southern Washington to Northern California from the shallow subtidal to 500 meters deep. We focused on nine species more or less severely infected and two without any record of disease. Depending on the species, observations were ranging from 86 to 1550 occurrences. Our study serves as a useful baseline of the species distributions before SSWD started. This distributional data and assessment of influential environmental factors will be valuable for future predictions or studies of the effects of bottom-contact ocean-use activities (e.g. fishing, renewable energy development) on sea star species as well as the effects of climate change. Understanding habitat conditions favorable for these species may be helpful in managing population recovery following disease outbreaks or other catastrophic events.

Risk Management of Catchments as basis for Integrated Water Cycle Management in Kazakhstan

Burghard Meyer, Lian Lundy, John Watt, Iskandar Abdullaev, Jose Capilla

Integrated Water Cycle Management (IWCM) aims to bring together a diversity of social, environmental, technological and economic aspects to implement sustainable water management systems. Developed to underpin a best practice study curriculum in IWCM for Kazakh Universities, a landscape and water based risk management approach was developed by an international multi-disciplinary team focused on sustainably managing highly stressed water resources at multileveled catchment scales. With a clear focus on modelling the risks driven by climate change unsustainable water use patterns (developed under differing socio-economic times) currently prevalent in both Kazakhstan and the Central Asian region, a strong emphasis is placed on integrated water management through risk communication, stakeholder engagement and governance. Risk management techniques are exemplified by the

development of a general risk assessment and management approach for Kazakhstan, the formulation of management skills for building capability, capacity and impact in IWCM, the development of an integrative methodology and of supporting tools for strategic risk management for decision making, and an approach to calibrate the context of trans-boundary water impacts using indicators including water availability, water chemistry and land degradation. The approach clarifies the crossing of landscape ecological knowledge in a wider context of water management in a region undergoing rapid socio-economic and environmental change.

Landscape Genetics: Insights into Amphibian Ecology and Evolution

**Andrew Storfer, School of Biological Sciences, Washington State University*

Landscape genetics is an interdisciplinary and integrative approach for testing the influence of landscape variables on spatial population genetic structure. Amphibians are particularly suited for landscape genetics studies because they generally have limited dispersal, are sensitive the the influence of landscape features and are difficult to survey by direct observation. Case studies using Pacific Northwestern North American amphibians will be presented on some of the most commonly addressed questions in landscape genetics, including: the effects of barriers, landscape variables, habitat fragmentation on spatial genetic structure. In addition, the effects of evaluating landscape genetic data across spatial and temporal scales will be addressed. Both intuitive and counter-intuitive results of each study will be highlighted and a discussion of future directions will be presented.

The Effect of Land Use on Carbon Stocks and Implications for Climate Variability on the Slopes of Mount Elgon, Eastern Uganda

F. Mugagga, Department of Geography, Geo Informatics and Climatic Sciences, Makerere University, Kampala, Uganda; B. Nagasha, Department of Environmental Management, Makerere University; B. Barasa, GIS Centre, College of Engineering, Design, Art and Techn

We investigated the impact of land use change on carbon stocks and its implications to climate variability in Mountain environments. Remotely sensed biophysical data was used to determine the extent of land use change over the last two decades. Land uses were stratified thus; forest under restoration, woodlots/plantations, agricultural land, regenerating forest and intact forest. Carbon in above and below ground biomass was measured using the allometric equations, whilst soil samples were analyzed for total carbon by the dry combustion method. The differences in carbon stocks in various land uses were analyzed using Analysis of variance (ANOVA). Top soil layers (0-10cm) were found to store more carbon than the deeper ones. Furthermore, intact forest stored more soil organic carbon (> 45t/ha) compared to other land uses with the least in land under agriculture (about 1.5 t/ha). The decimation of land uses with high carbon stocks was noted to reduce the potential of Mt. Elgon as a carbon sink. This therefore calls for the scaling out and up of forest restoration programmes in and around mountain environments, whose success will depend on the active participation of all stakeholders including, Uganda Wildlife Authority (UWA), local communities, politicians and leaders.

Quantifying landscape resistance to species dispersal from genetic data: a multi-site study on the meadow brown butterfly (Maniola jurtina)

Anne Villemey, National Research Institute of Science and Technology for Environment and Agriculture; Bill Peterman, University of Illinois; Murielle Richard, National Center for Scientific Research; Annie Ouin, University of Toulouse; Inge van Halder, U*

In the current context of loss and fragmentation of semi-natural habitats, interest in species dispersal is rapidly increasing. Landscape genetics has recently provided innovative solutions to evaluate landscape resistance to animal movement. However, studies often suffer from inadequate sampling designs (absence of spatial replication, opportunistic sampling) and incorrect statistical analyses (non-independence of pairwise genetic distances). We studied the widespread meadow brown butterfly Maniola jurtina. Samples were collected in 18 study landscapes of 5 x 5 km in three contrasting French regions (six study landscapes per region). As the distribution of M. jurtina is continuous rather than patchy, delineating population boundaries is particularly challenging. We therefore based our sampling design on individuals. We estimated genetic distances from 6 microsatellite loci. Using circuit theory, least cost path and strip-based methods, we analyzed landscape connectivity for each sex separately. We accounted for the non-independence of pairwise genetic distances in linear mixed models with maximum likelihood population effects parameterization. Analysis of 1681 samples collected in 2013 revealed that landscape characteristics explained only a small part of the genetic patterns. M. jurtina were weakly influenced by landscape features, but consistent results from different analytical methods and spatial replication give us confidence in the patterns we detected. Indeed, for both sexes, forests and arable lands limited butterfly dispersal whereas grasslands and linear elements enhanced gene flow. Landscape replication and the use of multiple analytical methods with appropriate statistics guarantee robust inferences.

Spatio-temporal remotely sensed data for analysis of the shrinkage and shifting in the Horqin sandy land, Inner Mongolia

Jinya Li,State Key Laboratory of Urban and Regional Ecology, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences

Facing the worsening degradation of grasslands, state and local governments in China have implemented a series of ecological protection projects. However, accurate, timely and effective monitoring and assessment are required to determine if these projects work well. The Horqin sandy land is the largest sandy land in China. In this paper, 18 banners (counties) were studied because they contain the Horqin sandy land. We interpreted Landsat TM/ETM+/OLI images of the study area from four years: 1985, 1992, 2001 and 2013.The following results were obtained. The total area of desertified grassland in Horqin increased from 18892 km2 in 1985 to 26709 km2 in 1992 and then decreased to 25482 km2 in 2001 and to 16559 km2 in 2013. The changes in the areas of desertified grassland with various degrees of desertification displayed the same trends as that of the total desertified grassland area. The annual rates of expansion of desertified grassland during the three periods were 5.91, -0.51 and -2.92%, respectively, and the corresponding expansion rates of severely desertified grassland were 10.44, -3.28 and -1.95%, respectively. The changes in temperature and precipitation did not benefit the reversal of grassland sandy desertification. The growing population and expansion of livestock production and farming inhibited the reversal of grassland sandy desertification. The results indicate that ecological engineering measures have helped reverse desertification and have promoted the restoration of grassland vegetation.

Geospatial constrains and opportunities in participatory forest management arrangements: from policy to practical solutions in Tanzania

Salla Eilola, University of Turku, Department of Geography and Geology; Nora Fagerholm, University of Turku, Department of Geography and Geology; Niina Kayhko, University of Turku, Department of Geography and Geology; Peter A. Minang, World Agroforestry*

Management of multifunctional landscapes with decentralized participatory approaches and better understanding of human-environment interactions by geospatial technologies have become prominent in Africa where climate change, declining natural resource base and increasing population undermine sustainable landscapes. In this presentation we will address institutional geospatial opportunities and challenges, which are faced in the practical implementation of participatory land use planning based on our case studies in Tanzania. Through our policy-practice analysis of the establishment of participatory forest management in Zanzibar, Tanzania and our study on the institutional dynamics of forest resource management in mainland Tanzania we exemplify the prerequisites, constraints and opportunities for participatory landscape planning and management supported by geospatial technologies. We address issues of access to geospatial data, capacity in applied use of geospatial technologies and participatory usage of the data. In both cases the policies endorse local participation and flexibility in implementation but active adoption of the approach and technologies in practice fall short for several reasons which will be discussed. We will also reflect on the implications of current practices in decentralized forest resource management to the sense of ownership, agency and cohesion in the local communities, which ultimately enhance sustainable development and management of landscapes.

Behavioural and habitat functional group responses of fish in estuaries affected by global change

Andrew T.M. Chin, University of Toronto; Marie-Josee Fortin, University of Toronto; Julia Linke, University of Toronto; Roland Cormier, Eco-Risk Management; Simon Courtenay, Canadian Water Network, University of Waterloo; Monica Boudreau, Fisheries and O*

Estuaries are highly dynamic aquatic ecosystems that are influenced by both natural and anthropogenic pressures that occur in the upstream watershed. Estuarine fish communities are particularly sensitive to the variability in intensity of stressors upstream resulting in species abundance changes. Fish communities can therefore be used as indicators of upstream stressors on the aquatic ecosystems downstream. Diadromous species, that inhabit the pelagic or demersal zone, may be more sensitive however to landscape pressures than non-diadromous pelagic and demersal species. To investigate these various differences in sensitivity to stressors, we classified species into different functional groups of estuarine fish communities: (1) trophic levels, (2) habitat zone, and (3) migratory behaviour. Using long-term monitoring data (Community Aquatic Monitoring Program) of estuarine fish community abundances and environmental data in New Brunswick (Canada), we found that the variation explained in the redundancy analysis of the functional migratory group was equivalent to the habitat group (R2adj = 0.578) and greater than the trophic group (R2adj = 0.469); whereas the migratory group combined with habitat grouping explained more variation (R2adj = 0.489) than combined with trophic grouping (R2adj = 0.470). We suggest that migratory and habitat groupings may indicate better species response to upstream stressors.

Assessing the efficiency of a protected area system in a Neotropical region using species distribution modeling

Nadja Gomes Machado1,2, Thomas Edwards3, Jacob Gibson4, Marcelo Sacardi Biudes2 1Federal Institute of Mato Grosso, Brazil 2Federal University of Mato Grosso, Brazil 3USGS/Utah State University, Logan, UT, USA 4Utah State Univ

Tropical ecosystems have complex ecological phenomena and high biodiversity, which are threatened by high rates of deforestation. In this context, it is important to have an efficient protected area system for biodiversity conservation. The establishment of those areas with subjective criteria results in a reserve system without adequate representation of biodiversity, which could hinder its long-term maintenance. Thus, the objective of this study was to evaluate whether the protected areas in Mato

Grosso state, Brazil are properly located to protect amphibians, birds and mammals. Species distribution predictions were generated for each group using occurrence data and environmental variables. Their protection percentage was established for each land use type. Mato Grosso state as one of the highest agricultural producers in Brazil has just 5.91% of its territory protected. In general, high protection areas had less than 3% of amphibians and mammals, and less than 1% of birds. Middle and low protection areas had less than 1% of birds and 2.5% of amphibians and mammal. On the other hand, high potential areas for resources such as forest and water had 12% of amphibians, 6.1% of birds and 25% of mammals whilst agricultural areas had 12.3% of amphibians, 8.3% of birds and 14.8% of mammals. The results showed that protected area system in Mato Grosso is inefficient because biodiversity is unprotected. The protected area system must incorporate more areas with the highest species distribution predictions. Thus, the next step will be to apply systematic conservation planning to indicate priority areas for biodiversity conservation.

An Agent-Based Model for Examining the Effects of Governance Structure on Spatially-Explicit Land- and Water-Use Patterns

*Lindsey S. Smart, Center for Geospatial Analytics, College of Natural Resources, NC State University**
Jordan W. Smith, Center for Geospatial Analytics, College of Natural Resources, NC State University

Water is frequently referred to as the 'world's most valuable resource.' The expanding global population is placing increasing stress on natural hydrological systems and their ability to sustainably supply adequate freshwater. Water-use governance systems are complex assemblages of households, private corporations and regulatory agencies, each of which places unique, and often competing demands, on the hydrological systems. The actions of these stakeholders result in dynamic and spatially-explicit land- and water-use patterns. In short, water demand and supply systems are complex socio-ecological systems that exhibit many dynamic processes such as feedback loops, emergence and nonlinearities. Agent-based models (ABMs) can be a powerful tool to better understand how the actions and interactions of stakeholders within a water system affect land- and water-use patterns. ABMs provide scientists with the ability to formalize system dynamics between environmental factors and the actions of individuals or institutions. Consequently, ABMs allow for the testing of management scenarios and consequences even before implementation, allowing for the exploration of spatial and temporal dynamics within the water resource system. In this paper, we present a relatively simple analytical framework for an ABM that operates on a synthetic landscape, with parameters easily transferrable for site-specific case studies. The agents within the model consist of diverse stakeholder types common to most hydrological governance systems. Governance structure (i.e., agents' connections to one another) is derived from modified Markov random graphs, allowing for an examination of discrete inter-agent dependence structures. Agents' land-use decisions are influenced by groundwater availability and quality, economic returns and social influences. Each of these spatially-explicit metrics is derived from a scientifically-grounded mathematical submodel. These models operate on a synthetic landscape to provide a better understanding of how interactions and feedbacks between agents' decisions lead to emergent properties such as changes to regional land-use patterns and the water table. The primary objective of this research is to construct a simple, transferrable model that is applicable irrespective of any particular landscape or water resource issue. The ABM framework provides scientists and stakeholders with the ability to explore how different governance structures lead to alternative land use patterns. Emergent spatial land- and water-use patterns can subsequently be used to inform policy, by offering solutions for more appropriately-structured governance networks that will maintain the continuous and sustainable supply of freshwater needed to support growing human populations.

From Environmental Patchiness to Ecological Scaling: the Roots of Scaling in Avian Community Ecology

John T. Rotenberry, University of Minnesota*

John Wiens' seminal review of spatial scaling in ecology has shaped ecological theory and application for the last 25 years, with over 2000 citations subsequent to its appearance in 1989. Wiens argues that issues of scale in space and time permeate all ecological investigations, and he describes the effects of scaling on ecological phenomena. His apprehension and understanding of these effects (e.g., relationship between physical and biological scales; system openness; extent and grain of environmental patchiness; population and system variance, equilibrium, and predictability; detecting patterns and inferring processes) were shaped by his earlier studies on avian communities in semi-arid grassland and shrubsteppe ecosystems. I examine the roots of this understanding by linking elements of that research (conducted during the 1960s, 1970s, and 1980s) to the synthesis that emerged in 1989. I suggest that the avian communities in these ecosystems may have been predisposed to suggest scaling effects, thus setting the stage for the emergent synthesis.

Using Surrogate Species to Capture the "Essence" of a Landscape

Paul Heimowitz, Stephen Zylstra - U.S. Fish and Wildlife Service, Pacific Regional Office; Jodie Delavan, Dolores Weisbaum -U.S. Fish and Wildlife Service, Oregon Fish and Wildlife Office*

Conservation planning at landscape- scales is necessary in the face of widespread challenges such as urbanization, invasive species and climate change. However, it can be difficult for scientists and planners to incorporate the complexity of multiple habitats and hundreds of species into decisions about on-the-ground actions. Similarly, landscape conservation - as a term and concept - is often too abstract to gain public relevancy and support. The U.S. Fish and Wildlife Service (USFWS) is applying a surrogate species approach to advance its Strategic Habitat Conservation model of adaptive management. Surrogate species are an ecological tool to reflect the conservation needs and key limiting factors of multiple species in an ecosystem and help target landscape conservation planning. In the USFWS Pacific Region, surrogate species also are used as a communications and engagement tool to symbolize the essence of ecoregions, and to help motivate the appreciation for and conservation of priority habitats. For example, the iconic Oregon white oak was selected as a surrogate species for the Willamette Valley landscape. This resulted in USFWS partnership with the Oakquest project, which engages local citizens and Native American youth in mapping and conserving oak woodland and savanna habitatsâ€¦in turn, extending conservation benefits to associated species like Western gray squirrel and acorn woodpecker. This presentation describes initial outcomes of efforts by the Service and its partners (particularly State Fish and Wildlife agencies) to identify, evaluate, and utilize surrogate species that promote landscape conservation in the Pacific Northwest and Hawaiian islands.

Sea ice and habitat preference of the Pacific walrus (Odobenus rosmarus divergens) in the Bering Sea: A multiscaled approach

Alexander E. Sacco, Andrew R. Mahoney - Geophysical Institute, University of Alaska Fairbanks; G. Carleton Ray, University of Virginia; Hajo Eicken, Geophysical Institute, University of Alaska Fairbanks; Mark Johnson, University of Alaska Fairbanks*

Pacific walruses, currently being considered for protection in the U.S. under the Endangered Species Act, spend winter and spring in the Bering Sea in order to mate, forage, and raise young on sea ice. While summer sea-ice decline threatens optimal foraging ability for the walrus population in the Chukchi Sea to the north, changes in the Bering Sea spring seascape may also represent challenges during critical stages of their reproductive cycle. Using remote sensing techniques to analyze seasonal changes in

Bering Sea ice conditions at an ice-patch scale (<2 km) and the seascape scale (10-300 km), we investigate relationships between spatial properties, and walrus use, of the sea-ice cover during the spring-melt period. Using high-resolution aerial imagery, we quantify patch-scale characteristics of the ice cover including the size, shape, and arrangement of ice floes in order to determine whether the floes occupied by walrus groups differ from those that are unoccupied. At this scale we find that walrus show little, if any, preference for sea-ice floe-size characteristics, while groups of adults without calves are observed in ice patches containing a greater concentration of young ice and floes that are more rounded in shape. To examine movement of walrus herds across the ice, we mapped the distribution of seascapes characterized by open water, dense pack and fragmented pack using synthetic aperture radar (SAR) data for 2006-2008. The proportion and distribution of fragmented-pack seascapes varied annually, but ship-based sightings show fragmented-pack seascapes are preferential for walrus over other seascapes, particularly in 2007.

Directions in Computationally Intensive Landscape Ecology

William W. Hargrove, USDA Forest Service; Forrest M. Hoffman, Oak Ridge National Laboratory; Jitendra Kumar, Oak Ridge National Laboratory; Steven P. Norman, USDA Forest Service*

We will briefly review several of our own computationally intensive landscape ecology applications, ranging from regional to global scales, many of which are based upon our parallel Multivariate Geographic Clustering (MGC) procedure, which produces homogeneous regions on a map consisting of all grid cells having similar mixtures of the input parameters. We have used MGC to produce national ecoregions, NEON domains, agroecozones, wildfire biophysical settings, Sudden Oak Death (SOD) regions, LIDAR vegetation structure zones, phenologcial ecoregions or "phenoregions," global fire regimes, and many other ecological zonations. MGC can quantify similarity between regions, can measure the representativeness of one or more samples in a network, can characterize the sharpness of ecoregion borders, and can produce "fences" along sharp instantaneous discontinuities in environmental properties. Our parallel PATH tool finds potential corridors of connectivity through a landscape by following the simulated stochastic movements of many millions of individuals, saving only the routes of successful dispersers. MGC can also be used as a form of rapid habitat or niche modeling for many hundreds of species. The first parallel computer available to us was one that we constructed ourselves using several hundred surplus personal computers. Some ecological applications are elegant in that they are nearly perfectly parallelizable, yet others yield only to brute force computing. In the satellite era, categorizations of the Earth's surface can be rapidly created and updated with improved speed and flexibility.

Landscapes historical persistence and stakeholders' perspective over traditional land-uses. The case of Romania's Carpathians

Ileana Patru-Stupariu, Institute of Research of University of Bucharest ICUB and Transdisciplinary Research Centre Landscape-Territory-Information Systems CeLTIS - Romania; Constantina Alina Hossu, Institute of Research of University of Bucharest ICUB an*

Cultural landscapes, created by traditional land use, are being threatened across Europe. Identifying landscapes persistence could reveal both important traditional cultural landscapes as well as landscapes that were affected by certain transformations. We used a GIS-based comparative analysis to identify the persistence of different land-cover types as well as qualitative interviews with stakeholders from three different cultural areas to examine their views regarding past and recent landscape changes. The study site is situated in the Romania's Southern Carpathians. Three land cover types (built-up, pastures and forests) were extracted using the maps produced in 1912, 1980 and 2009. The historical persistence for

selected land-cover types is low and varies from 14% for pastures to 16% for forests. Unchanged forests were located close to a national park, while persistent pastures were situated close to human settlements. The persistence of the built-up area is very small and consists of scattered patches that have emerged around historical monuments. The results of the stakeholders' interviews reveal important past and recent landscape changes under socioeconomic and political circumstances. The nature and extent of these changes have imprinted stakeholders' concerns over the futures of their landscapes. New planning strategies and more public participation in the local decision making processes are necessary in the region to conserve the remained unique cultural landscapes.

Patterns and drivers of farm-level land use change in selected European agrarian landscapes

Soren Bech Pilgaard Kristensen, University of Copenhagen; Anne Gravsholt Busck, University of Copenhagen*

Many semi-natural landscape elements found in agrarian landscapes in Europe, such as woodlots, hedgerows and grasslands, were originally part of the agricultural system. During the 20th century, they lost most of their functions and were often removed. Presently, many landscape and land use changes undertaken by farmers aim to restore or create new landscape elements. These activities are often subsidized to provide public goods or undertaken to fulfill personal and family motives. Despite similar policy framework at the supra-national scale in Europe, differences in agricultural potential, urban proximity and agricultural regimes, coupled with a profound diversity of farmer types and farming rationales results in a multitude of landscape changes at a regional and local scale. More information is needed to identify typical patterns of landscape change at farm level in different European landscapes and to correlate these with land owner profiles to better inform policy makers about land use decision-making in agrarian landscapes. For these reasons, we investigated the patterns of landscape changes that occurred between 2002 and 2012 in three different landscape regions of Europe (peri-urban landscapes, areas with marginal potential for agriculture, post-socialist landscapes) and the drivers behind, based on a questionnaire survey with 437 landowners in six study areas. Secondly, we studied landowners' decision-making strategy and correlated selected endogenous factors with landowners' involvement in land use changes. We will present typical and distinct land use change patterns for land owners in these landscapes and relate them to farm and landowner characteristics and conclude with important lessons for agri-environmental policy formulation.

When to burn a whole site? A spatially-explicit model evaluating demographic costs versus dispersal benefits for an endangered butterfly.

**Joseph Smokey, Washington State University; Cheryl Schultz, Washington State University; Norah Warchola, Washington State University; Elizabeth Crone, Tufts University*

As managers design burn strategies for prairie restoration, use of spatially-explicit models is an important tool to understand the role of metapopulation colonization dynamics of fire-restored habitat. For the endangered Fender's blue butterfly (Plebejus icarioides fenderi), previous field studies show that fire kills pre-diapause larvae, but improved habitat quality following a burn results in higher fecundity. Non-spatial models suggest a "best approach" of varying frequency of burn and portion of site burned that balances the tradeoff between very low survival immediately after a burn and higher fecundity in subsequent years. However, these models do not account for connectivity within the larger landscape. We construct a spatially-explicit individual-based model incorporating butterfly demography from a recent four-year fire field study to elucidate the benefits and consequences of various management strategies on a metapopulation in Eugene, Oregon. In our first management strategy, the optimal fire strategy predicted by the non-spatial model, small patches of habitat within a site are sub-divided into

sections to burn, allowing for within-site and nearby-site recolonization. In our second management strategy, all habitat within a site is burned at once, eliminating within-site recolonization and relying on recolonization from nearby sites for regional persistence. Using the model's predictions on population viability, residence time, and connectivity indices across various management strategies, we identify a suite of best approaches to using fire as a restoration method in a network of small, well-connected patches of habitat for an endangered butterfly and explore similar approaches for species inhabiting disturbance-maintained systems in fragmented landscapes.

Comparing global and European land use and land cover change models

Peter Verburg, VU University Amsterdam; Peter Alexander, The University of Edinburgh; Mark Rounsevell, The University of Edingburgh; Reinhard Prestele, VU University Amsterdam*

Model validation and sensitivity analysis is part of good modelling practice. However, land use models at continental to global scales have seldom been fully validated and also sensitivity analyses are scarce. This can be attributed to the lack of data that support a standard model validation. This presentation will present the current practice in validating European and global land change models and present the results of the LUC4C model intercomparison (MIP) to assess the performance and the structural uncertainty of land-use and land-cover change models at continental and global scales. The analysis identifies patterns of model types that are more likely to diverge from others, and quantifies major uncertainties, processes and scenarios where land use models are most robust. The analysis will also investigate the variation of spatial patterns between participating models, as well as the different spatial scales applied in the final results. The spatial part of the analysis will attempt to quantify the range of location disagreement that originates from differences in the procedures used to allocate land use categories to specific grid cells. Moreover, with special focus on land use-climate interactions spatial analysis will allow a further comparison of how different land use models spatially allocate land uses in relation to the algorithms used in DGVMs/ESMs to partition increasing agricultural area over grassland/forest. The presentation will provide a first insight in the uncertainties and variations involved in global and continental scale land change models that are underlying major assessments such as the IPCC and Global Biodiversity Outlook.

Values of Korean Tidal flat as National Park

Sun-Kee HONG, Institution for Marine & Island Cultures, Mokpo National University, Korea

Jeollanamdo Province has the largest tidal flat wetlands in Korea, and has a wide range of protected areas. Because of multi-level stakeholders related to the use of tidal flats by various government agencies and management system under the Act, conflict with residents and difficulty in effective use of tidal flat are increasing. In order to solve this complicated management system, government is preparing unification the existing protected areas of tidal flat in the national park system. To designate the national park, there are important details need to resolve. Landscape pattern of tidal flat in southwestern part of Korea is made up with 'communities of the island (Archipelago)' in unique ecosystem of tidal flats, and the fore-shore is being used by the islanders in multi-purpose ways. Conservation policies, therefore, will be needed more than just a sophisticated decision-making. In that sense, it is very appropriate that the management system of UNESCO Biosphere Reserve in pursuit of sustainable development of tidal flat ecosystem conservation will be regarded in the national park policy. Through overseas practices, new tools such as system improvement, ensuring activities of the inhabitants, ecosystem conservation and application of tidal flat are indispensable for improving local ecosystem and economy.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Using Nested Frameworks for Maintaining Biodiversity of Aquatic Resources in the Sonoran Desert

Joseph C. Drake, Texas Tech University, Department of Natural Resources Management; Nancy E. McIntyre, Texas Tech University, Department of Biological Sciences; Kerry L. Griffis-Kyle, Texas Tech University, Department of Natural Resources Management*

Connectivity and isolation are natural landscape elements, but we may need to manage these at different scales because of tradeoffs between the needs of habitat connectivity for native species and protection against hyperconnectivity that facilitates expansion of invasives and diseases. Using graph theory and movement distances of native amphibians as well as the invasive American bullfrog, we analyzed wetland networks comprised of natural and anthropogenic waterbodies in the Sonoran Desert. These networks are composed of habitat clusters that emerge at various dispersal distances, eventually coalescing to form a single network. We examined connectivity within a nested framework at the scale of the entire network as well as within clusters that emerge at bullfrog and native species dispersal distances. We identified clusters of connected wetlands important for native amphibians and examined several structural connectivity metrics at both the cluster scale as well as the overall network scale (e.g. average path length, node density, and identification of stepping-stones, hubs, and cutpoints). In addition we used circuit theory to identify corridors of dispersal among water sites. In so doing, we identified areas of potentially high ecological importance based on both graph theory and resistance mapping. Using a nested framework to identify important areas of structural and functional connectivity, both for native populations and for invasives, can help managers plan for the connectivity of resources in a way that addresses sometimes conflicting management goals.

Spatial trends in forest growth and mortality across the perhumid temperate rainforest of North America

Brian Buma, University of Alaska Southeast, Tara Barrett, US Forest Service, Sari Saunders, BC Forests, Paul Hennon, US Forest Service*

Natural forest growth and expansion are important carbon sequestration processes globally. While afforestation and recovery from historical land use sequester substantial amounts of C each year, observations of forest change in pre-existing, unmanaged systems can provide clues towards the sustainability of afforestation efforts in the context of climate change. Here, we explore regional changes in the unmanaged forests of the North American temperate rainforests in Alaska and BC, which store globally significant amounts of carbon in biomass and soil stocks. We demonstrate that the regional biome is shifting; gains exceed losses and are located in different spatio-topographic contexts. Forest gains are concentrated on northerly aspects, lower elevations, and higher latitudes, especially in sheltered areas, whereas loss is skewed towards southerly aspects and lower latitudes. Repeat plot-scale biomass data indicates that within-forest biomass gains outpace losses on gentler slopes and in higher latitudes. This work demonstrates that while temperate rainforest dynamics occur at fine spatial scales (less than 1000 m2); the net result of thousands of individual events is regionally patterned change. This work indicates that while afforestation and recovery from historical disturbances are significant, natural systems are also increasing in live biomass and growing in extent.

Spatial information and technologies in participatory mapping of community-based ecosystem services

Nora Fagerholm, University of Turku, Department of Geography and Geology; Niina Kayhko, University of Turku, Department of Geography and Geology; Salla Eilola, University of Turku, Department of Geography and Geology*

In this presentation we will address landscape management challenges in the context of subsistence-based communities in Zanzibar (Tanzania), where the agricultural practices are linked to the multiple benefits obtained from land and forests. Land management is a typical example where participation of the local level stakeholders is needed in a spatial form. Recently, there has been a growing enthusiasm concerning pursuing participation through the use of GIS (participatory GIS, PGIS) to complement the expert-based landscape analysis. With Zanzibari case studies, we will exemplify how participatory mapping, description and spatial analysis of community inhabitants' values and benefits attached to the landscape capture place-based local knowledge. This knowledge, especially on the material land uses (ecosystem/landscape services), create the prerequisites for the interpretation of landscape dynamics analysed through retrospective LC/LU mapping and change detection analysis. The non-material and cultural landscape values mapped by the stakeholders enrich the interpretation of this community-forest interaction. We will also suggest that integration of expert and local knowledge of landscapes through spatial analysis and participation has potential to enhance spatial argumentation about the complex socio-ecological interactions in landscapes. Spatial information and technologies have a high potential for planning and management processes, such as community forest management. An integrated spatial perspective is fundamental since it allows local-level, spatially specific discussions between stakeholders and has potential to create improved premises for landscape planning and management.

The Establishment Niche in the Landscape: Signals of Transition and Opportunities for Forest Persistence Under Climate Change

Josep M. Serra-Diaz, Arizona State University; Lynn Sweet, University of California Santa Barbara CA; Ian McCullough, University of California Santa Barbara CA; Janet Franklin, Arizona State University Tempe AZ ; Frank W. Davis, University of California*

Many species will face major changes in climate, which may cause changes in distribution. A critical question is, however, to what extent species will likely track those major shifts in climate. Little is known about how especially vulnerable tree stages respond to new climatic conditions. Importantly, seedlings respond at different spatial and temporal resolutions than adult trees do. For instance, years with climate conditions favoring seedling survival ('windows of opportunity') may be crucial to ensure forest regeneration and species migration. In this study, we performed a 2 year seedling experiment using a common garden experiment designed to capture a gradient of latitude and altitude in California, for a set of widespread oak and pine species. We built a model able to predict seedling establishment through time using high temporal and spatial resolution climate and hydrological variables. We evaluated trends of windows of opportunities for species seedling establishment through space and time for a set of climate change projections in three landscapes that showcase three major ecoclimatic conditions in California. Our results outline an overall trend of decreasing seedling survivorship under climate change, but reflect that local topoclimates may offer opportunities for species persistence in the landscape. Also, signals of temporal and spatial variation in windows of opportunity through time suggest a slowing down trend for the establishment opportunities for establishment and overall shrinking patterns. This patterns provide signals of a potential transition in composition in California forests.

Comparative analysis of Lugu Lake watershed ecosystem function under different management authorities

Rencai Dong,

In this paper, we use comparative analysis approach and satellite change detection analysis to study Lugu Lake watershed ecosystem, which is a trans-boundary lake lying at the border of Sichuan and

Yunnan Province, south-west China. Four factors that may greatly influence Lugu Lake watershed ecosystem are selected and compared between Sichuan and Yunnan portion of our study area at five different scales: province, city, county, town and village. These four factors are environmental management approaches, natural environment, local society and economy. To quantitatively analyze and compare the structure and function difference of Lugu Lake watershed ecosystem between Sichuan and Yunnan portion, we build an index system based on key environmental elements, including land-cover, forest stand structure, the value of ecosystem service, normalized difference vegetation index (NDVI), and calculate their values in these tow portions of our study area. Results showed that Lugu Lake watershed ecosystem was facing different degree of tourism pressure, agriculture pressure, public participation and environmental management approaches between Sichuan and Yunnan portion. We concluded that different pressure of human activities, especially tourism pressure, environmental management consciousness, and management approaches of local environmental management authorities, such as the implement of the Regulations on Restoring Farmland to Forest, were the major causes of the change in watershed ecosystem along Sichuan and Yunnan border of our study area.

Food for people and animals: Restoring African tropical rainforest to benefit wildlife and human well-being

Aerin L. Jacob, Department of Geography, University of Victoria, Victoria, BC, Canada; Martin J. Lechowicz, Department of Biology, McGill University, Montreal, QC, Canada; Colin A. Chapman, Department of Anthropology and McGill School of Environment, McG

The trajectory and speed of degraded forest recovery depends on a combination of factors, including land-use history and management intervention. Degraded forest is often considered â€˜restoredâ€™ once a threshold level of tree cover or diversity is reached, even though such forest may not provide food for animals or people. Working in Ugandaâ€™s Kibale National Park, we compared biodiversity and ecosystem services in intact tropical rainforests and forests recovering from human disturbances (e.g., logging, burning, farming, planting native or non-native trees). In each site, we quantified synergies and trade-offs among tree diversity, food production for elephants and primates, and indicators of provisioning, regulating, and cultural services for people. Multivariate analyses showed that high-quantity and quality of animal foods were consistently and positively related to most ecosystem services. However, despite intensive restoration, abandoned farmland planted with native trees does not yet have greater tree diversity, animal foods, or ecosystem services than passively regenerating areas. Taken together, our results demonstrate that managing degraded tropical rainforest to maximize stocks of animal foods has the potential to help maximize ecosystem services; however, managers could increase benefits for local wildlife and people by planting a wider functional and taxonomic variety of trees.

Changing Canadian farm landscapes by eating them: how food companies use stewardship and marketing programs to fill fields and forks.

Corry, Robert C., University of Guelph*

Canadian food systems - like those of many other nations - are not always directly linked to the domestic landscape because of the globalization of food supply chains. Yet more-local diets and sourcing are leading to changes in food supply chains that are beginning to affect farm landscapes, especially with respect to practices and management that improve sustainability in food production. Canadian food companies and grocers have sustainability initiatives for seafood, processing, and packaging. Not always

is a relationship to more-sustainable landscape services clear. This paper identifies food systems initiatives among large food companies in Canada to examine if and how they change the landscape in explicit ways. I show how a voluntary, measured farm program might lead to further changes through food supply chains and contrast this with a meat marketing program in Ontario that correlates with broad-scale landscape changes that challenge sustainability. Integrating data from large food suppliers with farmer organizations provides a baseline description of expectations for marketing and stewardship through traceable farm products. The paper concludes with some challenges for translating innovations at the farm-level to understandable indicators for consumers in the food marketplace.

Fishy' relationships: genomic investigations into dispersal patterns and family affairs.

Celia Schunter, King abdullah university of Science and Technology; Marta Pascual, University of Barcelona; John Carlos Garza, Southwest Fisheries Science Center, National Marine Fisheries Service and University of California; Fede Bartumeus, Centre d'Est

Connectivity is crucial for the persistence and resilience of marine species, the establishment of networks of marine protected areas and the delineation of fishery management units. Larval dispersal determines the connectivity patterns of many marine species but direct measures are scarce due to technical problems. Using single nucleotide polymorphisms (SNPs), we have measured direct dispersal of a small Mediterranean rocky-reef fish, Tripterygion delaisi (the black-faced blenny), through parentage analysis and sibship reconstruction. RNA-seq data from 15 individual samples were used for single nucleotide polymorphisms (SNPs) discovery applying a series of selection criteria. We genotyped 1598 adults and juveniles using 178 SNPs discovered in this effort. Parentage analysis identified 6.5% of the juveniles as self-recruits. Sibship reconstruction analysis found that, in general, full siblings did not recruit together to the same location, and that the largest distance between recruitment locations was much higher (11.5 km) than found for parent-offspring pairs (1.2 km). Spatial genetic similarity is analyzed in the two generations to investigate spatial and temporal settlement patterns, drift and selection and family structure. Although little genetic structuring could be detected on such a small geographic scale, by the means of clustering and networking analyses we found spatial subgroupings of related individuals.

Mapping Burn Scars on Mount Kenya, Central Kenya using Landsat Data and MODIS Active Fire Detection

Mary C. Henry, Miami University; John K. Maingi, Miami University; Jessica L. McCarty, Michigan Tech Research Institute; John Ngugi, Kenya Forestry Research Institute; Gabriel Muturi, Kenya Forestry Research Institute*

Mount Kenya is one of Kenya's "water towers" which are the headwaters for the country's major rivers including the Tana River and Ewaso Nyiro River. These rivers provide fresh water and hydroelectric power to the semiarid region, but fires in remote parts of Mount Kenya can have negative impacts downstream. Fires are difficult to monitor given limited resources of local land management agencies. Satellite-based remote sensing has potential to provide long term coverage of large remote areas on Mount Kenya, especially using the free Landsat data archive. In this study, we mapped burn scars on Mount Kenya using Landsat 5 Thematic Mapper (TM), Landsat 7 Enhanced Thematic Mapper Plus (ETM+), Landsat 8 Operational Land Imager (OLI) derived dNBR (Change in Normalized Burn Ratio) and Moderate Resolution Imaging Spectroradiometer (MODIS) active fire detection data for fires occurring 2000 to 2015. We also analyzed topographic position (elevation, slope, aspect) of these fires using Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)-derived 30-meter Digital Elevation Model (DEM). Field based information of recent fires from Kenya Wildlife Service (KWS), Kenya

Forestry Research Institute (KEFRI), and local media reports were used to verify fire locations when possible. Results indicate that dNBR images calculated from data acquired about one year apart were able to identify large fires on Mount Kenya that match locations (and timing) of MODIS active fire points from the same time period. Full results of our analysis will be presented here.

Land-use Change Analysis and its Impact on Water Resources of Upper Kharun Catchment, India

Navneet Kumar, Center for Development Research (ZEF) University of Bonn, Germany; Bernhard Tischbein, Center for Development Research (ZEF) University of Bonn, Germany; Mirza Kaleem Beg, Chhattisgarh Council of Science and Technology, India*

Land-use and its spatial pattern and dynamics strongly influence water resources & demand. Therefore, integrated water resources management coordinating water supply and demand is using modeling tools to assess the impact of land-use changes on the water balance and to conceive infrastructural and operational measures to cope with these impacts. This research combines the Soil and Water Assessment Tool (SWAT) and an advanced procedure for spatio-temporal land-use mapping that considers and integrates the intra annual variation within a single map and hence better represents an area with multiple crop rotations and different levels of urbanization. The study reveals that an increasing pumping rate of groundwater for irrigation is the main reason for decreasing the groundwater contribution to streamflow and subsequently a lowering in discharge and water yield. On the other hand, annual surface runoff is increased significantly by an expansion in built up areas over the decades in the study area. This information enhances the understanding of land-use changes and their relevant drivers, and facilitates the introduction of best water and land-use management practices.

Effect of research results on land management decisions done by environmental authorities in Tabasco

Lilly Gama, Hilda Diaz-Lopez, Ricardo Collado-Torres -Universidad Juarez Autonoma de Tabasco; Erika Salazar-Conde, Gobierno del Estado de Tabasco; Juan de Dios Valdez-Leal, Coral Pacheco-Figueroa, Eduardo Moguel-Ordonez - Universidad Juarez Autonoma de T*

Tabasco is located on the most vulnerable region of the Gulf of Mexico, due to several factors as its location, the richness of its resources and a complex hydrology system. Several natural and anthropogenic impacts have been registered. The results showed high economic losses. Research with government resources has been conducted to monitor territory changes, biodiversity loss and environmental impacts since 2003 to construct efficient environmental policy tools, such as the State Ecological Territorial Planning and the State Climate Change Program. These tools are used to regulate land use and productive activities inducing sustainable development, decreasing biodiversity loss and vulnerability, increasing resilience and promoting adaptation capabilities. The project objective analyzed the use and success of these tools to accomplish its aims. A land change analysis of the territory between 2003 and 2012 was performed to identify their changes and trends. Surveys were conducted among environmental authorities to evaluate if they knew the research used to construct the planning tools. An analysis of consultation type and frequency of these instruments and its application was made through the discussion. The results found that most authorities were aware of the studies especially on issues such as coastal erosion and vulnerability to hydro meteorological events. The consultation tools by authorities and consultants have increased annually not only due to an environmental state law requirement, but to a general concern associate to flooding impacts. The territorial analysis shows that trends have changed in some cases associated to the use of these tools but, not always.

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Wetland Landward Migration along the northern Gulf of Mexico under Future Sea-Level Rise and Urban Growth

Nicholas M. Enwright, U.S. Geological Survey National Wetlands Research Center; Michael J. Osland, U.S. Geological Survey National Wetlands Research Center; Kereen T. Griffith, Griffith Consulting at U.S. Geological Survey National Wetlands Research Cent*

In the coming century, accelerated sea-level rise (SLR) and urbanization will greatly modify coastal landscapes across the globe. As a result, ecologists and natural resource managers are increasingly challenged to better understand and prepare for the effects these future changes may have upon coastal ecosystems and the goods and services they support. In addition to providing fish and wildlife habitat, tidal saline wetlands maintain coastal food webs, protect coastlines, store carbon, remove nutrients, and provide recreational opportunities. Conservation planners have a strong interest in maintaining wetland ecosystem goods and services for current and future generations. In this study, we quantified the potential for tidal saline wetland landward migration along the U.S. Gulf of Mexico coast under alternative future SLR scenarios and urban growth projections. In undeveloped areas within our study region (five U.S. States: Texas, Louisiana, Mississippi, Alabama, and Florida), tidal saline wetlands may be able to migrate upslope and landward in response to SLR. However, where anthropogenic barriers are either currently present or expected to be present, landward migration will be prevented. Our results identify locations that allow for future migration corridors for tidal saline wetlands as well as areas where current or future urbanization may prevent migration. Collectively, our approach and findings provide useful information for environmental planners working to develop future-focused adaptation strategies for conserving coastal landscapes and wetland ecosystem goods and services.

Closing Discussion with Invited Speakers

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Recreational Value Assessment and Spatial Differentiation of the Jiuzhaigou Landscape

Bing Zhenhua, Ecosystem Service; Gao Jun,Ecotourism Management*

Jiuzhaigou is a national nature reserve, tourist attraction and World Natural Heritage site, and its managers face the challenge of protecting its environmental and cultural resources effectively while meeting the needs of recreational visitors. Methods such as contingent valuation (CVM) and travel cost (TCM) methods have been used to evaluate the total recreational value Jiuzhaigou but these cannot measure the individual recreational value of different tourism resources. This paper adopts the perspective of landscape services to identify and evaluate the value of such tourism resources. In addition, participatory mapping of recreational service points is used to reflect personal preferences in the perceived value of individual tourism resources across the valley. This study uses a combination of participatory mapping and CVM to determine tourists' evaluation of service points and willingness to pay for various recreation resources. The tourists also participated in determining the location of the landscape recreation points. Based on survey resultsï¼Œthe paper analysed the value of recreational resources and their spatial variation. A total of 730 respondents were interviewed whether they were willing to pay the recreational resources protection, and 614 valid responses obtained. The average tourist willingness to pay value was 354.98 yuan, and based on this figure, the recreational value of Jiuzhaigou was 0.94 billion yuan in 2012. The spatial distribution of high value recreation service points were concentrated on both sides of the developed valleys. Zharu valley received fewer visitors but had a higher recreational value.

Large area boreal forest vegetation assessment: implications of high-resolution remote sensing data and landscape characteristics

Kunwar K. Singh, Jonathan Henkelman, and Jill Johnstone Northern Plant Ecology Lab, Department of Biology University of Saskatchewan*

Accurate large-area vegetation composition information is fundamental to our ability to monitor biodiversity and global environmental changes to prioritize conservation and management plans. Moderate-resolution Landsat data is a primary source for monitoring changes at landscape to regional scales; however, ecosites in boreal forests are difficult to discriminate accurately at a relevant scale. High-resolution imagery, such as SPOT, offers solution to the challenge, but its use is constrained by inconsistent spatiotemporal coverage. We evaluate the hypothesis that ecosites assessed using high-resolution SPOT imagery would complement Landsat data to improve our ability in discriminating ecosites at regional to global scales with higher accuracies. To address this, we use field measurements, in conjunction with landscape and topographic data, to classify SPOT imagery into ecosites of the boreal shield of Saskatchewan, Canada. This outcome is then used in conjunction with a reflectance-normalized Landsat image to develop a large-area ecosites composition for the boreal shield. High band-to-band correlations between SPOT and Landsat imagery is suitable to carry out data normalization and data fusion for the analysis. We use the linear discriminant analysis, a commonly used statistical tool for the classification of surface features using satellite surface reflectance data, and the random forest algorithm, an ensemble classifier, to characterize spatial distribution of ecosites of boreal shield of Saskatchewan, Canada. We compare outcomes of SPOT, normalized imagery and Landsat-SPOT fusion data at multiple scales to determine the scale and resolution most relevant to identify critical habitat for threatened woodland caribou in northern Saskatchewan.

Drivers of Urban Sprawl in Europe

Ernest I. Hennig, Concordia University, Montreal, Quebec, Canada Jochen A.G. Jaeger, Concordia University, Montreal, Quebec, Canada Tomas Soukup, GISAT, Prague, Czech Republic, and European Topic Center of Land Use and Spatial Information (ETC LUSI), Cope

In order to control urban sprawl, it is necessary to better understand its drivers. Many potential drivers have been analyzed, but yet independently and for single countries or cities, which renders it difficult to draw general conclusions about their importance. We gathered data for 14 potential drivers for European territorial statistical units in 2006 and 2009. A multiple regression approach was employed using Weighted Urban Proliferation (WUP) to measure urban sprawl, and for its components dispersion (DIS), urban permeation (UP), and land uptake (LUP). The models explained a considerable amount of variation (all R2 > 70%). Population density was the most important driver of WUP and its components, explaining at least 35% of the overall regression effect. The second and third most important variables were road (> 11%) and rail density (> 13%). Driver importance changed only for land uptake (LUP) to Gross Domestic Product (> 11%) as the second most important driver, and relief energy (8%) in 2006, and governmental effectiveness (8%) in 2009 as the third most important driver. Population density was always fostering WUP and its components, while the other drivers had various effects on the metrics. This is the first study using information about almost the entire European continent, which allows to generalize on drivers of urban sprawl and their importance. Our results indicate that population density and variables related to mobility and economical productivity are the major drivers.

Carbon sink, source or equilibrium? How does the role of the U.S. Central Hardwood Forest change?

Wenchi Jin, University of Missouri; Hong S. He, University of Missouri; Frank R. Thompson III, Northern Research Station, USDA Forest Service; Wen J. Wang, University of Missouri*

The Central Hardwood Forest (CHF) sequesters more carbon than any other biome in the U.S. Currently it is a carbon sink recovering from forest clearing and subsequent agricultural abandonment in 1930s. It is uncertain 1) how long this biome would remain as a carbon sink, and 2) after the maximum carbon stock is reached, would it stay in an equilibrium or change into a carbon source. We used four forest models, which vary from empirical growth and yield model (FVS), to mechanistic ecosystem models (LINKAGES and ED) and forest landscape model (LANDIS Pro), to simulate carbon stock dynamics of the CHF from 1980s to 2380s. The four models produced different results in 1) time to reach the maximum carbon stock, 2) values of the maximum carbon stocks, and 3) carbon dynamics after the maximum carbon stock is reached. However, all four models agreed that the CHF will remain as a carbon sink up to 2050s. Maximum carbon stocks were reached in 2260s, 2130s, 2050s, and 2070s for FVS, LINKAGES, ED, and LANDIS Pro, respectively. The values of the maximum carbon stocks were 207, 145, 158, and 170 Mg C/ha for FVS, LINKAGES, ED, and LANDIS Pro, respectively. After the maximum carbon stocks were reached, FVS showed an unrealistic increase in carbon stock; both LINKAGES and ED showed a slight decrease; and LANDIS Pro showed oscillating changes between carbon sink and source, and the magnitude of the changes and intervals between oscillations decreased over time.

Landscape as a double ecotourist asset - PPGIS support for analysis of ecotourism potential in peripheral municipalities in Poland

Marcin RechciÅ„ski, Institute of Geography and Spatial Management Jagiellonian University in Krakow; Marianna Strzelecka, Department of Hospitality and Tourism Management University of North Texas; Malgorzata Grodzinska-Jurczak, Institute of Nature Conse*

Ecotourism, understood as a soft form of nature-based tourism, is often viewed by scholars as a solution that meets economic needs of local communities and nature conservation goals of protected areas (PAs). Meanwhile, potential for ecotourism is geographically diverse and it directly results from spatial distribution of various ecotourist assets. We propose that local landscape is the key one, as it contributes to the overall potential twofold: as objective features of environment (natural capital) and subjective meanings ascribed to it by local providers of ecotourism services (component of human

capital). While the former are usually natural resources of PAs, the latter result from perception of local landscape. We adopted Public Participation GIS (PPGIS) to identify local ecotourism potential in three Polish peripheral municipalities located within European Network of Natura 2000 sites. We conducted 28 PPGIS interviews with tourist stakeholders which included semi-structured paper-map based mapping. The mapping activity comprised designing polygons that represented e.g.1) features of environment valued due to its natural characteristics or economic utility and 2) subjectively-perceived sites with potential for ecotourism development. PP GIS analysis included simple answer counting and deepened analyses of spatial correlations of merged polygons depicting the mapping categories. Findings show that local stakeholders usually poorly identified natural assets of landscape, which could indicate limited human-capital component of the ecotourism potential. However, a significant spatial overlap between: 1) areas respondents found environmentally valuable, 2) places reported as preferred for ecotourism development and 3) centrally-designated Natura 2000 sites suggests a prospect for a pro-ecotourism turn.

Small Agricultural Areas Inside Cities: Vineyard Plots and Ecological Problems

Siegmar Thomas, Dresden University of Technology*

Not all urban open spaces, vegetation areas, mainly agricultural land, mitigate environmental problems to the same extent due to ecosystem services. All field crops up to shrub-like fruit plants are low-growing cultures and have lower phytomass compared to tree stands. They are steppe-like vegetation with relatively low environmental effectiveness. Observation of examples will show: Inappropriate land use, e.g. wrong or suboptimal site choice can have ecological consequences, also undesired side effects, and can affect optimal ecosystem services negatively and restricting due to faulty urban planning, in conjunction with modern "industry standards" for agricultural technology: Steeper slopes in unsuited exposure requires sometimes stronger use of pesticides with the consequence of increased soil, water, air pollution; clearing of woody stocks, (remaining) forests, groves in favor of agricultural crops may have adverse effects on urban climate (warmer and drier steppe climate, stronger cold air and storm exposure); level off the natural terrain relief causes reduction of spatial biodiversity ("Modern Landscaping" or intervention in nature and landscape?); strong herbicide use and mechanical measures of "excessive industrialized" agriculture cause reduction in spatial biodiversity, and increased wind and water erosion. On-site effects and spacious effect fields of ecosystem services are linked to the physical geography and land use patterns, and are modified by them and act on them. The spatial effect fields can extend far beyond administrative boundaries and land use units (surface water and groundwater currents of the river basins, atmospheric flow fields, soil movement paths ...). Clean air may be threatened by agricultural chemicals (pesticides), mainly through plots in the vicinity of residential areas. Urban landscape planning can help to protect largely ecosystem services and spatial biodiversity (safe distances; forest belts; principles of "agroforestry").

Landscape Characterization of Urban Heat Islands Using Land Use and Land Cover: A case study of Doha, Qatar

Yasuyo Makido, PhD, Research Associate, Toulan School of Urban Studies and Planning, Portland State University; Vivek Shandas, PhD, Associate Professor, Toulan School of Urban Studies and Planning, Portland State University; David Sailor, PhD, Professor,

This study examined a heat island magnitude model using land-use/land-cover (LULC) characters in Doha, Qatar. Vehicle temperature traverses were used to determine spatial differences in summertime air temperature across the study site. We employed a tree- structure regression model to quantify the LULC characteristics that have the largest impact on local urban heat island (UHI) intensity. With the

combination of multiple linear regression analysis, we estimated UHI intensity for three time periods: morning, midday, and evening. The most important determinant of UHI varied by day and time. Distance to the ocean was the most important determinant at midday, but albedo and percent urban area were more important factors for the other time periods. We also examined the relationships between predicted surface temperature and urban growth trajectories, which was characterized using K-mean cluster analysis. The results suggest that the landscape level factors are mediated by temporal variation, which impacts the selection of strategies to reduce heat stress.

Quantifying Landscape Fragmentation

Peter Vogt, European Commission Joint Research Centre (JRC)*

The provision of tools for monitoring and especially quantifying the impact of human activities on forest landscapes facilitate the design of efficient and assessable forest resource policies and risk assessment studies. Status and trends of land cover objects can be described by their pattern, connectivity, and fragmentation. While there are many quantitative measures for pattern and connectivity, fragmentation is usually provided as a qualitative description for a specific species living in the landscape under study. Yet, a meaningful understanding and interpretation of landscape dynamics in general requires a generic, reliable and especially quantitative assessment of fragmentation. This presentation will illustrate the concepts of normalized, quantitative fragmentation metrics describing the overall degree as well as the spatial distribution of fragmentation of any land cover type in digital image data. The proposed indices apply the holistic approach of spatial entropy instead of addressing and summarizing the many different aspects of fragmentation individually. Such normalized indices permit not only a concise state assessment on a given site but also the intercomparison of fragmentation for different sites. In addition, temporal changes can be localized and quantified. The reliable quantitative assessment of fragmentation is a prerequisite for any statistical analysis. Besides highlighting hotspots of changes it permits measuring, and thus evaluating the progress in biodiversity and landscape planning projects. The methodology was applied on a 25-meter resolution forest mask (CLC 2012) highlighting the spatial distribution of forest fragmentation caused by roads and railways in southern Germany and northern Switzerland.
Methods and tools for pattern, connectivity, fragmentation, and change analysis are summarized in the free software collection GuidosToolbox available at:
(http://forest.jrc.ec.europa.eu/download/software/guidos).

Group Discussion

Robert Gilmore Pontius Jr, Clark University; Rebecca Chapman, Clark University*

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Modelling species distributions in dynamic landscapes: the importance of the temporal dimension

Margaret E. Andrew, Murdoch University; Elizabeth Fox, BirdLife Australia*

A potential source of error in many species distribution models is a temporal mismatch between the species occurrence records and the environmental predictor variables that are used to model habitat relationships. Mismatches arise when environmental variables are either single-time snapshots or temporal averages that poorly represent the conditions actually experienced by a species at the particular time it occurred at that location. Temporal mismatches may be especially problematic in dynamic systems, such as arid and semi-arid environments, where weather patterns and resulting

resource pulses are unpredictable in space and time and where, consequently, vagile organisms are often relatively nomadic. We modelled the distributions of >30 bird species in the Great Western Woodlands (GWW) of Western Australia. The GWW are of considerable conservation importance regionally and globally: They are the largest remaining intact Mediterranean woodland worldwide and are part of the southwest Australia global biodiversity hotspot. The temporal dimension was added to distribution models with two types of environmental predictor variables: (1) time-specific estimates of gross primary productivity (GPP) and precipitation (aggregated over 1-, 3-, or 6-month periods prior to the survey date), and age of last fire; and (2) estimates of the temporal stability of GPP over the 14-year MODIS archive, providing an index of the degree to which sites might function as refugia from drought, fire, or other disturbances. Predictions were mapped out for several exemplary dates/conditions. Comparisons with traditional, static-environment distribution models emphasize the importance of explicitly considering time in dynamic landscapes.

Informing resource management by integrating probabilistic models of land change and ecosystem services

Monica A Dorning, USGS

To effectively make decisions regarding landscape management, regional planners need information about how different land-use and land-cover configurations may influence biodiversity and ecosystem service provision. Integrating models of land-use change with those of other ecological processes can provide unique insights and information that will help decision-makers weigh different land-use alternatives. We are using an integrated modeling approach to assess the landscape-scale impacts of energy development (building of oil and gas wells) on ecosystem services and wildlife habitat in sage brush ecosystems of Southwest Wyoming. Our approach involves coupling an established land-change model with the Artificial Intelligence for Ecosystem Services (ARIES) platform. The land change model is used to simulate future well pad development and accompanying expansion of road networks under alternative resource extraction scenarios. This model is coupled with ARIES to assess how those landscape changes are likely to impact a suite of ecosystem services, including the provision of wildlife habitat, grazing lands, and recreational opportunities. Integrating these probabilistic models enables us to investigate feedbacks between energy development strategies and ecosystem service provision while accounting for uncertainty in model predictions. We will also be able to examine the tradeoffs between strategies and identify those strategies that align well with management goals. Our ultimate objective is to create an assessment process that is usable by local decision makers. Therefore we are exploring techniques for evaluating the effectiveness of the overall approach, the resulting visualizations, and the communication of uncertainty across space and time.

Towards national mapping of aquatic condition (I): The Stream-Catchment (StreamCat) Dataset

Marc H. Weber, US EPA; Ryan A. Hill, US EPA; Scott G. Leibowitz, US EPA; Anthony R. Olsen, US EPA

Stream environments reflect, in part, the hydrologic integration of upstream landscapes. Characterizing upstream features is critical for effectively understanding, managing, and conserving riverine ecosystems. However, watershed delineation is a major challenge if hundreds to thousands of watersheds must be delineated or if a study spans a large geographic extent. Further, site-specific watershed delineations do not provide a framework for easily and quickly applying analytical results to new, un-sampled locations. We developed a database of >100 landscape metrics for ~2.7 million watersheds within the conterminous USA: The Stream-Catchment (StreamCat) Dataset. These landscape metrics include both natural (e.g., climate, soils, geology) and anthropogenic (e.g., dams, agriculture, urbanization) factors, and were derived within and link to the National Hydrography Dataset Plus v.2

(NHDPlusV2), allowing for rapid extraction of upstream characteristics for stream-based studies. The framework uses topological flow information contained within the NHDPlusV2 to summarize upstream characteristics for each NHDPlusV2 stream segment. Locations of field samples can be integrated with the framework of upstream landscape metrics to derive site-based watershed metrics. Variation in landscape features or model results can be presented visually and provide a unique tool for assessing analyses. We provide an example of how the framework can be used to visualize variation in key landscape indicators of water quality such as urbanization and provide an input to national stream biological condition modeling. In addition to streams, we show how the process can be applied to derive a similar framework for lakes.

Towards an understanding of land consumption in Germany

Marco Schwarzak, Leibniz Institute of Ecological Urban and Regional Development; Martin Behnisch, Leibniz Institute of Ecological Urban and Regional Development; Odette Kretschmer, Leibniz Institute of Ecological Urban and Regional Development; Gotthard*

The continuing growth of area used for settlement and transportation (land "consumption") is an international phenomenon. The proclamation of the year 2015 as the 'International Year of Soils' (IYS) recently emphasized "the importance of sustainable soil management as the basis for food systems, fuel and fibre production, ecosystem functions and adaptation to climate change for present and future generations". In Germany the national sustainability strategy 2020 outlines the goal of reducing land consumption to 30 hectares a day. The intention of the presentation is a quantitative exploration of land consumption, with respect to the characteristics extent, physical structure and spatial distribution. In this context the weighted urban proliferation (WUP) is presented as an important indicator to measure different characteristics of sprawl in Germany. It is calculated on the level of all municipalities (=11.441) in Germany. The results emphasize different capacities of spatial data to represent the amount and shape of built-up areas (e.g. Corine Land Cover, urban footprint, soil sealing, digital landscape model, ATKIS data, official buildings polygons) and their effects on the total result of WUP as well as the components of its calculation (e.g. dispersion, density, urban permeation). The presentation further encourages discussions and expansions on the compilation of attributes that serves the verification and falsification of hypotheses regarding drivers of land consumption. So called multidimensional analyses are presented for this issue by focusing on the discovery, interpretation, and presentation of information embedded in large and complex land use data sets.

Factors that Cause the Rise of Temperature in Modernization for Adaptation Strategies to Climate Change

Chika Takatori, Nagoya University, Graduate School of Environmental Studies, 3-33-1 Motoyama-Cho, Chikusa Ku, Nagoya City, Aichi Prefecture

Global warming and the heat island phenomenon have serious effects on human health in metropolitan areas. An appropriate adaptation strategy is needed to address these effects. In this study, we simulated the thermal and wind environments using a supercomputer, and clarified the dominant factors that cause the rise of temperature by comparing the thermal and wind environments of two periods: the Meiji Period (1884) and the present (2006) using geographic information software. The horizontal simulation area is 7.5kmÃ—7.5km, and 400m in height. The mesh resolution is five meters. The simulation model simultaneously handles flows of wind of the upper boundary layer and the micro-climate in the canopy layer, in which the heat exchange of different layers actively occurs at an altitude of 50m-100m above ground level. As a result, the dominant factors were statistically clarified that influence the rise of temperature and velocity between the two periods. Regression analysis was

conducted, in which the change of land cover on the micro topography and the change of wind flow in upper layer were set as independent variables, the change of temperature and wind velocity in the canopy layer were set as explained variables. The results show how the change of green space and buildings influences the rise of temperature in hierarchical scales. Effective indicators and metrics were devised and used to inform the next step which is to devise adaptation strategies to climate change by accounting for future land use changes.

Multi-scale Analysis of Relationships between Agricultural Landscape Pattern and Drought Vulnerability

Mengjie LI,State Key Laboratory of Earth Surface Processes and Resource Ecology, Beijing Normal University &Academy of Disaster Reduction and Emergency Management, Ministry of Civil Affairs & Ministry of Education, Beijing Normal University; Deyong YU, S*

As a country with large population, food security in China has always been the hot spots in international society. Unprecedented crop failures caused by natural disasters, especially droughts, are the main factors of production fluctuation. To reduce the losses caused by natural disasters, a lot of adaptation measures have been raised, among which adjustments in land use might be the most effective. This paper uses agricultural land use data (including statistical data and remote sensing data) and drought data of China at national, provincial and municipal scales to examine the relationships between agricultural land use and agriculture drought and try to find out reasonable adjustments in land use that can be adopted to relieve the multiple pressures of agricultural drought vulnerability, rural poverty and ecological security. The results show that the three aspects of land use patterns: arable land distribution, the composition and configuration of arable land and arable land management will all influence the extent of drought-induced production losses. But not all factors are significant at all three scales. At national scale, the effective irrigated area is the most significant factors, but at provincial scale, the significance of crop diversity stands out. And when analyzing the results at municipal scale, we can see that some landscape pattern indices also have a role to play in determining drought effects, which helps to optimize land use pattern.

Estimating dispersal rates and landscape resistance to understand functional connectivity for a long-lived endangered species

Alexander D. Wright, Warnell School of Forestry & Natural Resources, University of Georgia & Joseph W. Jones Ecological Research Center; Jeffrey Hepinstall-Cymerman, Warnell School of Forestry & Natural Resources, University of Georgia; Lora L. Smith, Jos

Habitat loss, fragmentation, and degradation have led to an estimated 80% range-wide decline of gopher tortoise (Gopherus polyphemus) populations across the Coastal Plain of the southeastern United States. Recently, the gopher tortoise was identified as a candidate for federal listing under the Endangered Species Act in the eastern part of its range. This project is part of a larger research effort developing an adaptive landscape planning and decision framework to be implemented by the Georgia Department of Natural Resources for the conservation of viable gopher tortoise populations. Currently, we are investigating the dispersal rate and functional connectivity (i.e. the movement of individuals among habitat patches) of gopher tortoises. Specifically, we are conducting a mark-recapture study of four study populations, and the surrounding area, at the Joseph W. Jones Ecological Research Center, an approximately ~ 11,000 ha private reserve in southwestern Georgia, where individuals were previously marked between 1995 and 1999. These data will allow estimation of a landscape resistance surface for modeling tortoise movement potential in an individual-based model (IBM) to test how landscape composition and configuration affects gopher tortoise population connectivity. A preliminary IBM of the

system using simulated data indicates a positive relationship with mean patch size and a negative relationship with the cost-distance between the populations. By further understanding these integral parts of tortoise ecology, we can better understand and evaluate the connectivity of known populations in Georgia to help guide state-wide land-management decisions.

Methodological and Analytical Frontiers for Agent-based Models of Spatially Dynamic Landscape-Scale Processes

Jordan Smith, Center for Geospatial Analytics, NCSU; Lindsey Smart,Center for Geospatial Analytics, NCSU; Georgina Sanchez, Center for Geospatial Analytics, NCSU; & Ross Meentemeyer, Center for Geospatial Analytics, NCSU.*

Spatially dynamic landscape-scale processes vary widely across domain areas, with study systems ranging from urban growth to the spread of plant pathogens. These processes are shaped by complex interactions between natural and human systems, however disconnects between the methodological and analytical models used by computational modelers, geospatial information scientists and social scientists, has made transdisciplinary work difficult. The purpose of this review is to explicitly detail methodological and analytical frontiers for linking data and models utilized by biophysical and social scientists studying spatially dynamic landscape-scale processes. We achieve this by detailing how spatially dynamic landscape-scale processes are coupled natural and human systems. We subsequently review and classify the existing literature on spatially dynamic landscape-scale processes based on five distinct characteristics: i) method of collecting data on human behavior and decision making; ii) method of modeling spatial dynamics across the landscape; iii) method of linking human behavior and decision making data to geospatial models; iv) the scale of data collection and modeling efforts across both natural and human systems; and finally v) the focus of the study system. Drawing upon this review, we highlight methodological and analytical frontiers that can advance our understanding of spatially dynamic landscape-scale processes. We specifically focus on data collection methods and modeling tools that allow for the hard- and spatially-explicit coupling of contingent human behaviors and decisions to landscape-scale spatial dynamics.

Joint spatial analysis of water policies and hydrologic ecosystem services in an agricultural landscape

Jiangxiao Qiu, Zoology, University of Wisconsin-Madison, Madison, WI; Chloe B. Wardropper, Nelson Institute for Environmental Studies, University of Wisconsin-Madison, Madison, WI; Adena R. Rissman, Forest and Wildlife Ecology, University of Wisconsin-Ma*

Managing hydrologic ecosystem services (freshwater benefits generated by terrestrial ecosystems) in regional watersheds is challenged by the complex network of multi-level policies. However, the effectiveness of water policies is seldom assessed spatially, and few studies have investigated the spatial concordance between water-related policies and delivery of hydrologic services. In an urbanizing agricultural landscape, we asked: (1) Whether public interventions to improve water quality coincided spatially with hydrologic services? (2) Whether their spatial concordance varied by government level (federal, state, county and municipal) and intervention type (land acquisition, direct management, incentive and regulation)? We merged spatial analyses of 35 interventions with mapping of four hydrologic services (surface- and groundwater quality, freshwater supply, and flood regulation) in the 1,336-km2 Yahara Watershed (Wisconsin, USA). Spatial concordance between areas of intervention and hydrologic services varied widely among interventions, reflecting different priorities or constraints of each intervention. Cumulative areas of intervention showed positive correlations with surface- and groundwater quality (both $p<0.01$), suggesting less interventions on locales with the highest threats to water quality. However, interventions were negatively correlated with freshwater supply and flood

mitigation (both $p<0.01$), indicating discordance between the targeting of water quality policies and other hydrologic services. Spatial overlap also varied by government level and intervention type: acquisition aligned with areas of water quality concern, enhanced water supply and flood mitigation, whereas other intervention tools showed opposite alignment. Our results demonstrate that joint spatial analysis of policy application and ecosystem services would help evaluate and enhance targeting of interventions at the landscape level.

Modelling issues arising from international landscape fire simulation comparisons

Geoffrey J. Cary, The Australian National University and Bushfire Cooperative Research Centre; Robert E. Keane, USDA Forest Service; Mike D. Flannigan, University of Alberta; Ian D. Davies, The Australian National University; Chao Li, Canadian Forest Ser*

Empirical and simulation studies indicate the potential for considerable changes to area burned with global warming and other aspects of global change in temperate and boreal forest landscapes. Insights into likely changes in fire occurrence are critical for informing future management in fire-prone environments and for accurately representing fire dynamics in Dynamic Global Vegetation Models. Since 2004, a community of modellers from Australia, Canada and the USA have been studying the relative importance of climate change and other key determinants of area burned in temperate and boreal forest landscapes using a suite of landscape-scale fire simulation models from around the world. Two climate change experiments were conducted across five models and incorporated several other factors including weather variability, variation in landscape attributes, and variation in rates of vegetation succession. Using these simulation experiments, we will explore strengths and limitations of our multi-model comparison framework. Strengths include methods for determining consensus among models, and ranking of climate effects against non-climate influences in the overall design. Limitations include imperfect standardisation of non-climate variables, and the need for increased representation of key processes including, for example, global change effects on fuel dynamics. Addressing these limitations will require collaboration across the Forest Landscape Model community.

Assessing functional connectivity in the face of uncertainty about population processes: a Bayesian modeling approach applied to conservation of the gopher tortoise in Georgia, USA

Bryan L. Nuse, Georgia Cooperative Fish and Wildlife Research Unit, Warnell School of Forestry and Natural Resources, University of Georgia; Jeffrey Hepinstall-Cymerman, Warnell School of Forestry and Natural Resources, University of Georgia; Clinton T.*

Functional connectivity between animal populations can be difficult to assess, especially for long-lived species. However, understanding connectivity is critical to conservation strategy, because the degree of connectivity among patches determines whether classical metapopulation principles should be applied. The gopher tortoise is a keystone species in fire-dependent pine forests of the southeastern USA, and is a candidate for federal listing under the Endangered Species Act in the eastern part of its range. Tortoises may live as long as 6-10 decades, and generally maintain fairly small home ranges (< 1 to a few hectares). Consequently only a few long-term population studies have been performed. Several of these have reported infrequent long-distance movements (1-2 kilometers), however. We developed a Bayesian population model that uses recently acquired survey data, published demographic and movement rates, and habitat attributes to predict two features of gopher tortoise populations: density, and the potential for a patch to export individuals. The Bayesian modeling framework allows incorporation of various hypotheses regarding unknown population processes, such as fecundity. We use our model in combination with a movement resistance map to identify complexes of habitat patches that may be functionally connected, and within which metapopulation processes may be expected to

operate. This information is being used as part of a larger tortoise conservation planning tool that will guide land protection actions by the Georgia Department of Natural Resources.

Relationship between environmental properties, land use and the resilience to landscape degradation in Malopolska Region (Poland)

Agnieszka Nowak, Institute of Geography and Spatial Management, Jagiellonian University

Landscape degradation may be understood as the degradation of environmental elements such as soils, waters or vegetation which lead to the limitation of functions and services provided. In case of agrarian landscapes which link production and ecological functions it is especially important issue. In this regard Malopolska Region account for interesting area as on the one hand it is region of relatively high percentage of arable land (61%) but low intensity of agriculture (average size of farm here is 3.9 ha) and on the other hand its physiographic conditions (often long and steep slopes, shallow soils, relatively high precipitation) make it especially vulnerable to landscape degradation. At the same time, this region is internally diversified regarding natural conditions, type and the intensity of land use and, in consequence, resilience to landscape degradation which is exemplified by analyses conducted in seven test areas. Aim of the presentation is to show the relationship between environmental properties, land use and resilience to landscape degradation within test areas. Types of considered degradation include: soil erosion, nutrients loss, water pollution and habitat fragmentation. Such analyses should be involved in sustainable management of landscape.

An analysis of spatio-temporal landscape patterns for protected areas in northern New England: 1900-2010

Spencer R. Meyer, Yale School of Forestry and Environmental Studies; M. Kate Beard, University of Maine; Christopher Cronan, University of Maine; and Robert J. Lilieholm, University of Maine;*

Landscape ecology theory provides insight about how large assemblages of protected areas (PAs) should be configured to protect biodiversity. We adapted these theories to evaluate whether the emergence of decentralized land protection in a largely private landscape followed the principles of reserve design. Our objectives were to determine: (1) Are there distinct clusters of PAs in time and space? (2) Are PAs becoming more spatially clustered through time, and (3) Does the resulting PA portfolio have traits characteristic of ideal reserve design? We developed a historical dataset of the PAs enacted since 1900 in the northern New England region of the U.S. We conducted spatio-temporal clustering, landscape pattern, and aggregation analyses at both the landscape scale and for specific classes of landownership, conservation method, and degree of protection. We found the frequency of PAs increased through time, and that area-weighted clusters of PAs were heavily influenced by a few recent large PAs focused on natural resource management. PA clustering around preexisting PAs was driven primarily by large PAs focused on natural resource management, rather than strict reserves. Since 1990, the complete portfolio has increased in aggregation, but independently reserve patches have become less aggregated and smaller, while patches that allow extractive uses became more aggregated and larger. Our extension of landscape ecology theory to a diverse portfolio of PAs underscores the importance of prioritizing conservation in the context of existing PAs, as well as the contribution of large conservation easements to the overall conservation portfolio.

Workshop 2: Guided discussions aiming at a collaborative article

Frederik Doyon, Institut des sciences de la foret temperee, Universite du Quebec en Outaouais

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IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Diversity of Carabids (Coleoptera, Carabidae) in the Intensified Agricultural Landscapes of Northern China

Yunhui Liu, Zhenrong Yu, Changliu Wang, Xuzhu Zhang, Meichun Duan, Liangtao Li -China Agricultural University*

Knowledge of spatial diversity patterns is a key prerequisite for the development of effective strategies of biodiversity conservation in agricultural landscape. This research investigated the diversity pattern of Carabid (Coleoptera, Carabidae) in different semi-natural lands and cropped fields in the agricultural landscapes of Northern China, and analyzed the factors driving this distribution. The results showed (1) Semi-natural field margin harbored significantly higher numbers of both species and individuals than the internal of field, whereas assemblages within the field had a low diversity and a homogeneous species composition. (2) Species composition were distinct with habitat type and vegetation structureï¼›Extensive managed orchards sustained comparable carabid diversity with or even greater carabid diversity than in semi-natural lands. (3) carabid functional groups showed varied association with local plant diversity, habitat type and landscape diversity; predatory carabids tended to be more strongly related to less intensively managed and woody structured habitats. (4) Habitat type played a most important role in affecting the diversity of carabid assemblages than local plant diversity, while landscape structure showed little affects. It is concluded, 1) In the intensively managed agro-landscape, maintenance of heterogeneous landscape with both diverse semi-natural habitats and cropping systems and creating a more complex vegetation structure would be the most efficient measures to enhance the diversity of carabid assemblages. 2) The differentiated responses between functional groups should be appreciated in conservation management; particularly, extensively managed habitats coupled with a targeted increase in the local plant diversity is crucial to optimize the biological pest control by carabid assemblages.

Functional connectivity modeling and optimal siting of conservation networks in the Midwest USA

Theodore Weber, The Conservation Fund; John Norman, U.S. Department of Agriculture, Natural Resources Conservation Service*

With the rising costs of fossil fuels and recognition of their environmental and human health impacts, wind energy projects have expanded throughout the world. Under the U.S. Endangered Species Act, wind developers must avoid, minimize, and mitigate impacts to listed species. With assistance from the Conservation Fund, the U.S. Fish and Wildlife Service sought to address potential wind energy impacts in the Midwest USA. To provide ecosystem and landscape contexts for mitigation, we identified key habitat ("core areas") important to the full suite of native species and ecosystems, and corridors that would allow species dispersal, migration, recolonization, genetic exchange, and climate change adaptation. We identified core areas based on landscape types, focal/surrogate species requirements, and ecoregional differences. Corridors depend on both the composition and spatial arrangement of the landscape, and the movement abilities and landscape preferences of target organisms. We created a Terrestrial Movement Analysis tool to model connectivity for four different ecotypes, each with their own core areas and movement permeabilities. The tool generated random sets of starting locations (each location corresponding to an individual organism) and calculated optimal paths to all other habitat within the organism's dispersal range. This process was executed iteratively; then it summed the random iterations to derive overall landscape connectivity, showing pathway usage, the cost of moving through a corridor (broader than single paths), and overall landscape movement potential. The resulting data can be used for multiple applications.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Mapping population health vulnerability due to heat stress in China

Pan Xie, College of Urban and Environmental Sciences, Peking University; Yanglin Wang, College of Urban and Environmental Sciences, Peking University; Jian Peng, College of Urban and Environmental Sciences, Peking University*

The increase in the number and severity of extreme heat associated with climate change has highlighted the needs for research into vulnerability assessment. Vulnerability to heat stress has been identified and mapped in the urban areas in previous researches. However, only limited work has examined heat stress vulnerability in whole China, including those nonurban locations. By taking account of heat stress, sensitivity and adaptive capacity, this study computed heat stress vulnerability in both daytime and nighttime for county level across China, which offers diverse landscapes and population with varying socio-demographic characteristics. The most vulnerable counties are rural areas in basins or plains which are more easily to experience a high temperature and have less adaptive capacity to fight for the heat, mainly located in provinces such as Henan, Guangxi, Hunan, and Anhui. However, several metropolitan areas (i.e., Shanghai and Shenzhen) also experience relatively high heat stress vulnerability due to aggregation of vulnerable population (the old and women) or high unemployment rate. In the daytime, the counties with the greatest heat vulnerability are located in the north and west of China (i.e., Xinjiang, Ningxia, and Inner Mongolia), while in the nighttime, high vulnerability counties are located in the southeast of China (i.e., Henan, Anhui, Hunan, and Guangxi). This research aims to set a framework for county-level heat stress vulnerability assessment that can provide valuable decision support for climate adaption planning, emergency management, as well as resource distribution optimization.

An eco-evolutionary IBM improves predictions of future genetic connectivity for American Pikas (Ochotona princeps) in Crater Lake National Park, Oregon

Jessica Castillo, Oregon State University; Donelle Schwalm, Oregon State University; Clinton Epps, Oregon State University; William Monahan, National Park Service, Inventory and Monitoring Division; Nathan Schumaker, US Environmental Protection Agency; T*

In the face of rapid, contemporary climate change, conservation biologists are relying heavily on species distribution models (SDMs) to predict shifting occupancy and distribution patterns in response to future conditions. These models are critical tools for assessing vulnerability to climate change. However, SDMs are often limited to climate variables, neglecting to incorporate other factors which drive occupancy patterns and ultimately population viability. For example, SDMs fail to capture species-landscape interactions (e.g., dispersal ability and behavior) that can be significant drivers of not only occupancy rates, but also gene flow and genetic diversity. This is particularly concerning for species restricted to specialized habitats which are spatially disjunct. Here, we expand on traditional approaches used to explore the species-climate change interaction. First, we develop an SDM for the American pika (Ochotona princeps) using a combination of climatic and habitat variables, including connectivity metrics derived from empirical genetic data. We then predict occupancy in the contemporary landscape, as well as in three future timesteps with two scenarios depicting possible future conditions. We use an empirically-derived landscape resistance and demographic model in HexSim to investigate demographic and genetic consequences of changing occupancy patterns for American pikas in Crater Lake National Park, Oregon. Finally, we evaluate the potential for artificial habitat construction and translocation to improve future population connectivity and genetic diversity. Our approach ranks alternate conservation strategies intended to improve gene-flow and long-term population viability, providing critical insights that will inform the management of this climate-sensitive species.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Traditional management techniques in the conservation of sacred groves of south-west Nigeria

Oyelowo O.J., Forestry Research Institute of Nigeria; Aduradola, A.M., Federal University of Agriculture, Abeokuta, Nigeria; Onadeko S.A.,Federal University of Agriculture, Abeokuta, Nigeria; Agboola D.A.,Federal University of Agriculture, Abeokuta, Nige*

There are many great sacred groves in southwestern Nigeria that are related to diverse cultural identities. The two communities of Igbara-Oke and Ibere where Igbo-Olua and Igbo-Ile sacred groves are located were purposely selected to investigate the existing traditional management techniques adopted by the two communities. The total of 150 questionnaire was administered randomly to custodians (16), community heads (40) and residents (94) in the 2 communities, while 147 questionnaires were recovered. 72.82% respondents were male while 27.18% were female. Christianity had the highest percentage of 47.98 compared with Muslim (31.04%) and traditionalist (11.18%), others (9.76%). Farming (50.06%) was the major occupation of the respondents, followed by Trading (24%), Artisan (11.48%), Civil servant (10.44%) and the least was student (4%). 74.66% of respondents believed that the main function of the sacred grove is for the spiritual purpose compared to environmental purpose (17.81%), Burial purpose (4.11%), while the least is recreational purpose (3.43%). All the respondents (100%) affirmed to the ownership of the sacred groves to be owned by the communities. Local people, community leaders, custodians shared the responsibilities of protecting the sacred groves. In Igbo-Ile, 93.3% respondents attached the protection of the grove to local people, followed by costodians (6.7%). However, Igbo-Olua showed higher percentage recorded against community leaders as the protectors of the grove. Higher percentage (83.3%) entered Igbo-Ile for hunting, while the trees and other forms of plant are protected till date. Rituals and worshiping of gods faded away when the community started embracing western religion. Majority of respondents (43.3%) in Igbo-Olua responded they did not enter the grove, followed by appease (30%) and 26.7% entered for the purpose to worship and for festivals. Laws and punishment vary from one sacred grove to the other, but the two sacred groves affirmed that the punishment of the intruders goes beyond physical. Punishments in the sacred groves are inflicted by deities in the groves. The punishments vary from diseases to instant death. Intruders into Igbo-Olua escape punishment if certain rituals are made on time, but there are some penalties that do not accept rituals. Advocating the utilization of these cultural values in a framework to encourage conservation at local levels has practical implications for sacred grove protection.

Floral resources of an invasive shrub suppress native bee communities along forest edges in an intensive agricultural landscape.

Michael Cunningham-Minnick, Miami University; Valerie E. Peters, Miami University; Thomas O. Crist, Miami University*

Habitat loss and fragmentation are known causes of global declines in biodiversity and ecosystem services. In intensively managed agricultural landscapes, many bees and their pollination services are confined to areas near forest or grassland remnants. Plant species also invade these remnants, further reducing bee diversity by suppressing native floral resources. Although some bees use floral resources of invasive plants, their effects on bee diversity and pollination services are unclear. We quantified these responses by conducting a floral manipulation experiment with Lonicera maackii, an invasive understory shrub in eastern forests of the United States. In spring of 2013 and 2014, we removed L. maackii flower buds using a paired 100m removal and control plots along five forest edges adjacent to soybean or corn monocultures in southern Ohio. We sampled the bee community and measured pollination services at distances up to 200m from the forest edge. Although surrounding landscape variables were important predictors of bee community diversity, in 2013 we found no differences in species composition between treatments and a modest 7% increase in bee abundance in plots without flowers. However, 2014 data

indicated a 36% increase in bee abundance in flower removal plots and a decrease in seed set of sentinel plants near the forest edge in the presence of L. maackii flowers. The observed suppression of the bee community and its pollination services in the presence of L. maackii flowers provide strong evidence that land use and invasive species interact to affect biodiversity and ecosystem services in agricultural landscapes.

Phenological mismatch between migratory bird arrival and green-up due to climate change

Stephen J. Mayor, Memorial University of Newfoundland; Robert P. Guralnick, University of Colorado; Morgan W. Tingley, University of Connecticut; Javier Otegui, University of Colorado; John C. Withey, Florida International University; Sarah C. Elmendorf,

Migratory birds, given their ability to move long distances, might be expected to be among the most adaptable to climate change. However, birds must anticipate climatic conditions of their distant breeding grounds from their wintering grounds, which is complicated by greater climatic change at higher latitudes. While food emergence at the breeding grounds is driven by annually variable climate, birds are driven to migrate primarily instead by hormonal responses to light cues such as photoperiod, which is constant across years. The phenological mismatch hypothesis predicts that migratory bird populations will be unable to synchronize their migratory arrival dates to the timing of spring "green-up", when food resources become plentiful, as climate change progresses. We present a continental scale study testing this hypothesis with arrival estimated from citizen science records (eBird) for 48 common North American bird species over the 2001-2012 period. Improving on previous studies examining correlations to temperature, we instead used remotely sensed vegetation green-up (MODIS), a close proxy of resource availability. We show that asynchrony between arrival and green-up was significant in 47 species, and was strongly related to earlier green-up: birds did not adjust their arrival sufficiently in areas where green-up was early. Asynchrony significantly increased for 11 species, all of which breed in eastern temperate forests, and while they trended toward arriving earlier, green-up advanced at a faster pace. Our results support the phenological mismatch hypothesis, and suggest that such mismatches are becoming more extreme in areas most affected by climate change.

A Riverscape Genetics Approach for evaluating Multiple Factors Affecting the Successful Reintroduction of Bull Trout into the Lower Pend Oreille River, WA, USA

Meryl Mims, University of Washington; Andrew Bearlin, Seattle City Light; Jacob Burkhart, University of Missouri; Casey Day, Purdue University; Matthew Fuller, Duke University; Jameson Hinkle, Virginia Commonwealth University; Erin Landguth, University o*

Successful reintroduction of previously extirpated species often depends upon a combination of environmental, demographic, and genetic factors. Data-driven simulation-based models are promising tools for evaluating the independent and combined effects of these factors on the outcomes of reintroduction and management strategies. We developed a data-driven system model for bull trout (Salvelinus confluentus) in three watersheds of the Pend Oreille River system in northeastern Washington State, USA, where local extirpations of bull trout are linked to in-stream barriers, habitat degradation, invasive species and other factors. We used an individual-based simulation program designed to enable spatially-explicit quantification of how the stream environment affects genetic and demographic connectivity patterns. As part of the adaptive management suite of conservation and remediation measures benefiting fish resources impacted by the Boundary hydroelectric dam on the Pend Oreille River, we constructed a range of reintroduction strategies to evaluate how stocking protocol, life history variation, and the riverscape interact to influence the demographic and genetic characteristics of the reintroduced bull trout populations. Simulations evaluated patterns of population

(demographic and genetic) viability over time and showed that demogenetics outcomes were highly sensitive to the influence of supplementation stocks. Finally, once reintroduction strategies producing stable populations for multiple generations were identified, we evaluated the effects of a range of riverscape connectivity scenarios (e.g., barrier removal) on the demography and genetic structure of populations. Our results highlight the utility of considering multiple demographic, genetic, and environmental factors in critically evaluating the likelihood of success for a range of reintroduction strategies.

Milan Urban Region and urban sprawl

Claudia Canedoli, Francesco Crocco, Emilio Padoa-Schioppa -Dipartimento di Scienze dell'Ambiente e del Territorio UniversitÃ degli Studi di Milano-Bicocca*

Milan is the economic capital of Italy and the urban area surrounding the city represent the largest metropolitan area in terms of inhabitants and spatial extent. Despite recent economic recession, urban expansion is still dramatically persistent and it is one of the major cause of natural resources depletion by transforming large rural and natural areas into residential or industrial areas and by fragmenting the landscape. We analysed the spatial extent of the Milan Urban Region (UR) and we proposed a methodology to define it that can be easily implemented to different study area using GIS and data on population. We also describe the trend of the urban sprawl over a period of sixty years (from 1954 to 2012) using landscape's metrics. The Urban Region obtained for the year 2012 is about 665000 ha and includes 2 minor city and 763 municipalities. Relative Shannon's Entropy of the UR ranges from 0.83 (year 1954) to 0.92 (year 2012). Urban planners have to deal with what seems to be the most structural complex urbanised area of Italy and there is a strong need to managed sustainably the development of the area surrounding the UR with a regard to preserving natural resources such as soil.

Closing Discussion & Concluding Remarks

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Quantification and mapping of ecosystem service demand

Peter H Verburg, VU University Amsterdam; Sarah Wolff, VU University Amsterdam*

Mapping the demand for ecosystem services (ES) has received increased attention in scientific research as it is an essential component in operationalization of the ES concept. Quantification and mapping of ES demand is required to inform conservation planning, land use planning and management. Yet, there is a varying understanding of the concept of ES demand, which has implications on how and where ES demand is being mapped. We identified from the literature three distinct "demand types", which relate to different ecosystem service categories. These demand types include demand expressed in terms of (1) risk reduction, (2) preferences and values and (3) consumption or use of goods and services. In this paper we provide an overview of methods to map demand for ES at different spatial scales: the landscape level, the continental level and the global level. Methods to scale local studies of ES demand to larger scales will be illustrated with a cross-comparison and meta-analysis of cultural ES landscape preference studies. The examples illustrate the different methods used for different services and how to account for spatial flows between areas of ES supply and ES demand.

Human Adaptation to Fire Prone Ecosystems: Heterogeneity in Forest Management and Fire Hazard Conditions in the Eastern Cascades of Oregon

Susan Charnley, US Forest Service; Thomas A. Spies, US Forest Service; Michelle Steen-Adams, University of New England*

This paper investigates human adaptation to fire-prone landscapes in the Eastern Cascades of Oregon by examining landowner heterogeneity and feedbacks between forest management actions and landscape conditions on large land ownerships (federal, state, private industrial, tribal). The research questions addressed are: 1) How are large landowners ("actors") currently managing their forestlands to reduce fire hazard? 2) How do landscape conditions and social drivers influence forest and fire management by these actors? 3) How do fire hazard conditions vary by ownership? 4) What are the implications of our findings for improving human adaptation to fire-prone ecosystems in the future? Our analysis combines data about forest and fire management from agency databases and semi-structured interviews with data on current and future fire hazard conditions derived from fire and vegetation modelling, and scenarios generated using an agent-based landscape model. We find that forest and fire management by large actors varies within and between ownership categories, and individual ownerships, as do fire hazard conditions. Variation between ownership categories and among owners within the same category is primarily due to differences in management objectives and social drivers influencing management. Variation within individual ownerships is largely due to differences in environmental conditions and management histories. By illustrating how social drivers and landscape conditions influence management practices on large ownerships, and the landscape outcomes of these practices for fire hazard, this paper increases understanding of socioecological system heterogeneity and interactions in coupled human-natural systems, and points to more adaptive policy and practices for managing fire-prone landscapes.

Are agri-environmental schemes effective for the sustainable provision of ecosystem services?: Case of Noto peninsula, Japan

Shizuka Hashimoto and Tomoya Kishioka, Graduate School of Global Environmental Studies, Kyoto University

Agri-environmental schemes have been implemented in various countries since late 1980s in order to encourage farmers to carry out environmentally beneficial activities on their farmland. Japan is one of such countries. Learning from the EU's experiences, Japan has introduced an agri-environmental scheme for farmland located in less favored areas since 2000, and has expanded its target areas introducing additional schemes. These schemes are expected to contribute to the sustainable provision of ecosystem services arising from farmland such as provisioning, regulating and cultural services, while providing farmers with increased income opportunities in the form of subsidies. However, only a few efforts have been made to examine the effectiveness of those schemes. This study aims to explore the effectiveness and limitations of agri-environmental schemes by examining how schemes contribute to sustain the provision of agricultural ecosystem services with geo-spatial analysis. Noto peninsula was chosen as a study area, which has been designated as one of the Globally Important Agricultural Heritage Systems. Our analysis has identified that, first, although Noto has rich social-ecological production landscapes across the peninsula, it has suffered from farmland abandonment at least in the past three decades in large part due to its hilly and mountainous geography. Second, farmlands with an agro-environmental scheme were less-susceptible to abandonment even in unfavorable production conditions compared with those without the scheme. Third, the combination of multiple schemes increases the sustainability of farm cultivation than single schemes.

Modeling potential cellulosic and traditional biofuel impacts on land use under a changing climate in the northern Great Plains

Terry Sohl, U.S. Geological Survey; Ryan Reker, Inuteq; Kristi Sayler, U.S. Geological Survey; Yingxin Gu, Inuteq; Bruce Wylie, U.S. Geological Survey; Jordan Dornbierer, Caribou Thunder Limited (CTL); Steve Wika, SGT; Rob Quenzer, SGT*

Traditional biofuels have substantially altered land use and land cover in the northern Great Plains. Cellulosic feedstocks may have a similarly strong impact on land use as processing technologies mature. This work modeled the impacts of both traditional and cellulosic biofuel on northern Great Plains land use, using 1) regional biofuel modeling from the U.S. Department of Energy (DOE) 2) remote sensing and statistically based models of site-level suitability for biofuel feedstocks 3) projected climate scenarios, and 4) the spatially explicit land-use model FORE-SCE. The DOE's Billion Ton Update provided regional projections of harvested acreage of cropland and cellulosic feedstocks. Estimated switchgrass productivity was estimated with a remote sensing approach, with site-level suitability for both switchgrass and traditional crops estimated with statistical models. Current landscape conditions were provided by the USDA's Cropland Data Layer and the National Land Cover Database. FORE-SCE used Billion Ton Update results to model regional areal proportions of traditional crops and cellulosic feedstocks, with suitability surfaces used to guide the spatial modeling of biofuel crops under changing climate conditions. The resulting spatially explicit, thematically detailed land-use maps are being used to assess both carbon impacts and biodiversity implications of an expanding biofuels industry in the region.

Landscape Assessment of White-Lipped Peccary and King Vulture Habitat in the Calakmul Biosphere Reserve in the Southern Yucatan Peninsula, Mexico

Heather Cormier, Clark University; Mary Cox*, Clark University; Marissa Gallant*, Clark University; Sophie Calme, Universite de Sherbrooke, El Colegio de le Frontera; John Rogan, Clark University; Arthur Elmes, Clark University*

Effective landscape planning for highly mobile endangered species, with vast habitat ranges facing multiple climate-anthropogenic threats, is especially challenging across intra- and inter-national borders. This paper presents a case study of a novel multi-scale approach to assess and monitor habitat viability of threatened/endangered species over large geographic expanses and various political jurisdictions. The approach uses presence-only species data, climate and forest phenology information, and expert counsel to determine the potential distribution of wide-ranging species. By combining Mahalanobis Typicality species distribution modeling with a dynamic patch-corridor model, using Idrisi Land Change Modeler, this study determines the potential optimal landscape structure required to support viable populations. The Calakmul Biosphere Reserve (CBR) is a 7,238 km2 expanse of protected tropical forest located within the Southern Yucatan Peninsula, Mexico, serving as vital habitat for many species, including the white-lipped peccary (Tayassu pecari) and the king vulture (Sarcoramphus papa). The effectiveness of the CBR in conserving suitable habitat for these 'ecosystem engineers' is compromised due to increasing human population density, encroaching agriculture, poaching, and a hotter/drier climate. Results indicate that while the CBR effectively protects significant primary habitat, within twenty years of land change, 30% of primary habitat remains vulnerable to loss inside the CBR, while 35% of unprotected primary habitat falls outside it. Patch-model results indicate the optimal locations of patches of primary habitat and corridor areas in and around the CBR. This approach is applied to the entire potential range of the peccary and vulture within Central America, and preliminary results are provided.

Landscape Approaches to Modeling Cross-boundary Ecosystem Services: Introduction and Proposed Project with Migratory Bats

Kristen Lear, University of Georgia; Jeffrey Hepinstall-Cymerman, University of Georgia*

In today's global society ecological and conservation issues often cross political and geographic boundaries. Ecosystem services (the ways in which ecosystems and the associated species sustain and fulfill human life) can be used as a powerful framework to approach complex global challenges across local, regional, and national borders. Our symposium, "Landscape Approaches to Modeling Cross-boundary Ecosystem Services", aims to bring together experts in ecology, environmental economics, and social science to discuss landscape scale analysis of a variety of cross-boundary ecosystem services such as provisioning services (e.g. fuel and timber), regulating services (e.g. water purification, crop pollination, and biological control of pests), supporting services (e.g. habitat for species), and cultural services (e.g. recreation and aesthetic value). In the first portion of this talk we will introduce the symposium topic and objectives, namely to: provide a forum for examining the key benefits and challenges of a landscape scale approach to modeling cross-boundary ecosystem services from ecological, economic, and social perspectives; provide insight into the use of ecosystem services in policy, decision-making, and management at the landscape scale; and develop ideas and "best practices" to guide future research and decision making. In the second portion we will offer an example of proposed research in which we are using this combined lens to conceptualize and evaluate the pollination services provided by migratory nectarivorous bats and the interplay between agave cultivation in Mexico and bat conservation within an international transboundary context.

Charting the Unknown: A methodological approach to identify and assess uncertainties in landscape planning

Felix Neuendorf, Leibniz Universitat Hannover; Christina von Haaren, Leibniz Universitat Hannover; Christian Albert, Leibniz Universitat Hannover & Helmholtz Centre for Environmental Research; Frank Schaarschmidt, Leibniz Universitat Hannover

Uncertainties inherent in projections about landscape change have recently increased due to new or more volatile drivers of an accelerated land use change. In consequence, weaknesses of landscape planning in identifying and quantifying uncertainties, as well as towards appropriately communicating them to decision-makers are more acutely perceived. So far knowledge is lacking how uncertain results of conventional landscape planning approaches are and when complex models may be more appropriate. The objectives of this contribution are to present an innovative framework for the systematic assessment of uncertainties in landscape planning, and to test its application in a case study. We used a comprehensive literature review to identify typical sources of uncertainty and to develop an analytic "uncertainty in landscape planning" framework. Existing methods for assessing uncertainties from various scientific fields were synthesized and explored concerning their appropriateness in the context of landscape planning. The case study application illustrates the uncertainties inherent in a landscape planning process to safeguard and enhance carbon retention in soils in a watershed in the region of Hannover, Germany. Our preliminary results illustrate different options for the spatial assessment and visualization of data and method uncertainties and shed light on important knowledge gaps and research opportunities.

Cross-pattern and cross-scale interaction effects of landscape characteristics on avian persistence thresholds: implications for broad-scale conservation

Kevin J. Gutzwiller, Baylor University; Samuel K. Riffell, Mississippi State University; Curtis H. Flather, USDA Forest Service*

Abrupt spatial changes in bird species persistence associated with human land use may manifest as threshold relationships. To develop knowledge about the complexity of these relationships, we assessed

whether they involved cross-pattern or cross-scale interaction effects. A cross-pattern interaction involved a landscape composition variable (percent cover) and a landscape configuration variable (edge density, patch density, or nearest-neighbor distance) within the same spatial extent; a cross-scale interaction involved the same landscape characteristic (composition or configuration variable) at different spatial extents. Two spatial extents were studied: an area within 3 km of the route for bird counts, and a 23- or 25-km-radius area centered on the route for bird counts. Across three physiographic regions in the conterminous United States, analyses involving Breeding Bird Survey data, the National Land Cover Data, and multivariate adaptive regression splines indicated that cross-pattern and cross-scale interactions were involved in threshold relationships for 12 and 11 species, respectively. By definition, an interaction effect implies that the influence of one factor on the response variable varies with the level of the other interacting factor. Consequently, cross-pattern and cross-scale interactions, if undetected, may thwart the effectiveness of conservation planning and management when bird-landscape relationships are applied across a range of landscape conditions. Such impacts may be particularly problematic when threshold relationships are involved because small changes in interacting variables near threshold points may induce abrupt changes in avian persistence. Including cross-product terms as candidate variables in statistical models can advance the understanding of cross-pattern and cross-scale interaction effects.

Cumulative Effects of Twenty-Nine Years of Wildfires on Habitat Abundance in the Eastern Cascade Mountains of Oregon, Washington, and Northern California, USA

Mario Elia, Department of Agriculture and Environmental Sciences, University of Bari, Italy; Matthew J. Reilly, Pacii¬c Northwest Research Station, USDA Forest Service, Corvallis, Oregon, USA; Raffaele Lafortezza, Department of Agriculture and Environmen

During the last 30 years wildfires have increased in frequency and extent across much of the western United States. Most ecological studies have focused on patterns of burn severity within fire boundaries and nowadays there is great uncertainty regarding the cumulative effects of wildfires at greater spatial scales. We assess the cumulative effects of 29 years of wildfires on habitat abundance across the eastern Cascade Mountains of Oregon, Washington, and Northern California and address three hypotheses: (i) the effects of wildfires on habitat abundance varying by scale and intensifying with increasing spatial resolution; (ii) the effects of wildfires on changes in habitat abundance differing in vegetation zone and the changes that correspond with historical disturbance regimes related to climate; and (iii) the percentage change of habitat abundance differing by structural class. Our findings showed differences across scales, between vegetation zones and structural classes in terms of habitat abundance. At ecoregionl scale, few changes were found compared to the Late Successional Reserve scale. Fires affect small areas relative to total forest area. Further, the results indicate a significant change in subalpine vegetation zone historically covered by high severity fires, a moderate change in mixed conifer and the least change in ponderosa pine, the latter being more prone to fire. A better understanding of the effects of recent fires on habitat abundance is essential for managers as they work toward landscape-scale biodiversity conservation and forest resilience goals.

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On the emergence of ecological scaling in landscape systems

Bai-Lian Larry Li, Ecological Complexity and Modeling Laboratory, University of California at Riverside

A common feature of most ecological phenomena is an essentially hierarchical structure. This, in turn, may impose a bound on predictability or reasoning depending on the scale of spatio-temporal averaging. Thus, different types of methods are required for making prediction at different scales within the hierarchy. A log-log plot of landscape data has the great property of displaying, more often than not, a straight line over a certain range of parameters. There is a widely spread tendency to look for simple, ideal explanation; one often interprets a straight line as a scaling law (self-similarity or scale invariance) reflecting some important information. Here I will analytically demonstrate how deeply misleading this quest for simple interpretation can be. I will show that so many different things (e.g., data grouping, mixed probability distributions, noise-induced transitions, multiplicative branching processes, neighboring interactions, etc.) can produce a power-law distribution. In many cases, there is no single ecological mechanism behind the scale invariance. Using transect data, I argue that the departures from the power-law should not necessarily be explained by the finite size of the data set, but could result from a deeper departure from the power-law hypothesis. I also argue that current fractal approach is inconsistent with ecological hierarchy theory because of no existence of a hierarchy of characteristic scales in space or time and all scales treated as playing the same role. Ecologically, spatiotemporal scales give us access to additional information and clues about the underlying processes and the existence of a hierarchy of preferred scales. Studies of fractals in landscape ecology have now evolved from descriptive to the beginning of understanding.

Applying urban landscape ecology: lessons from and for practice

Joan Iverson Nassauer, School of Natural Resources and Environment, University of Michigan, USA*

This paper will address why and how well urban ecological knowledge is applied in design, engineering, and planning practice. It will examine how different approaches to generating urban ecological knowledge and to making science knowledge available, combined with different urban economic and governance contexts for employing this knowledge, affect practice. It will address why some aspects of urban ecological knowledge are used and some relatively unused in practice, and why some needed urban ecological knowledge is generally available to practitioners and some is not. To suggest lessons for practice, it will draw on cases from American cities that exhibit different economic and governance characteristics. For these cases, it will examine urban ecological knowledge that was needed, available and employed in practice, as well as related landscape practices that have been suggested, employed, or sustained over time.

Ecological network maintains genetic diversity and fitness of a flagship wildflower

Michelle F DiLeo and Helene H Wagner Department of Ecology and Evolutionary Biology, University of Toronto Mississauga*

Ecological networks can be an efficient way to reconnect populations in remnant patches in fragmented landscapes. Yet few studies have evaluated if the enhanced connectivity provided by ecological networks is enough to maintain genetic diversity and fitness of populations. Ultimately, these are the parameters that are most important for determining population viability. Here we test the efficacy of an ecological network implemented in southern Germany 25 years ago to reconnect abandoned calcareous grassland fragments through rotational shepherding. We genotyped individuals from 54 populations using eight highly polymorphic microsatellite markers and measured fitness-related traits in 10 populations of Pulsatilla vulgaris, a flagship species of calcareous grasslands in Europe and one of high conservation concern. We tested if the shepherding network explained functional connectivity in P. vulgaris and if enhanced connectivity translated to enhanced genetic diversity and fitness in connected populations. A Bayesian assignment test revealed that genetic structure of P. vulgaris populations

matched well to shepherding routes, and genetic connectivity was better explained by distance through grazing routes (r2=0.29, p<0.001) than geographic distance alone (r2=-0.003, p=0.35) in a linear model. Populations that were well connected within the ecological network had significantly higher genetic diversity than populations that were more isolated or outside the network (r2=0.29, p<0.001), and genetic diversity and seed set were significantly positively correlated (r2=0.53, p<0.01). Together these results suggest that shepherding has increased functional connectivity among fragmented populations of P. vulgaris, but populations that have low connectivity within the network still suffer from reduced genetic diversity and fitness.

Spatiotemporal dynamics of salt marsh in the Yangtze Estuary: observations with a modeling approach

Zhenming Ge, State Key Laboratory of Estuarine and Coastal Research, East China Normal University, China

The mudflat accretion, vegetation succession, plant invasion and associated anthropogenic impacts, make the Yangtze Estuary an ideal area for the study of salt marsh dynamics. In order to understand the biotic and abiotic factors regulating the spatiotemporal dynamics of salt marsh vegetation in relation to the expansion of the exotic plant (Spartina alterniflora) and the consequent responses of native species (Phragmites australis and Scirpus mariqueter), a grid-based model was developed incorporating the key ecological processes at Chongming Dongtan and Jiuduansha wetlands. During the simulation period of 2000-2008, the area of S. mariqueter decreased significantly at both wetlands, due to the rapid expansion of S. alterniflora. The expansion rate of P. australis was slow. When compared with observations, the simulated spatiotemporal dynamics of salt marsh vegetation showed a percentage match of 73%-91%. The accuracy of the distribution area for each salt marsh species was even higher (89%-97%). Both simulation and observation revealed that the period of early salt marsh succession was crucial for colonization and establishment of S. alterniflora after its introduction. Projections for the period 2008-2015 indicated that the expansion rate of S. alterniflora would slow down. In contrast, the model predicted that the distribution of S. mariqueter and P. australis would increase at a steady pace. The probable reason behind this is that the accretion of habitat above the elevation threshold at the current rate of sedimentation is marginal compared to the previously rapid rate of habitat colonisation by S. alterniflora over the past decade.

To plant or not to plant? Trade-offs in ecosystem services of fruit orchards and fallows in a shifting cultivation SES

Sylvia L.R. Wood, Bioversity International & Earth Institute, Columbia University; Jeanine M. Rhemtulla, Dept of Geography, McGill University; Oliver T. Coomes, Dept of Geography, McGill University

Farmers are under ever growing pressure to increase the productivity of their land to meet food and fibre demand as well as rising household economic demands. In shifting cultivation, farmers are taking advantage of traditional forest fallow periods to plant commercially oriented orchards to increase output. While there is likely an economic advantage to this intensification pathway, are there consequent ecosystem service trade-offs to replacing forest fallows with low diversity orchards? In this study, we compare the capacity of native forest fallows versus planted umari orchards in the Peruvian Amazon to provide critical ecosystem services underpinning subsistence shifting cultivation and tree biodiversity. We also estimate potential and actual revenues sources from fallows and orchards to quantify the economic incentives behind orchard planting. Although low in biodiversity, planted orchards provided similar or higher levels of most ecosystem services at the stand-level (soil fertility, wild fruit, carbon sequestration), however landscape-level services (pollination and pest control) could

be compromised as orchard planting rates increase. Meanwhile, economic revenues from orchards were modest, suggesting that orchards are more likely an income diversification strategy rather than an intensification strategy. Orchard planting may thus be a risk spreading and ecologically viable intensification pathway.

Question & Answer

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Overall discussion and conclusions: How can the issue of scale be appropriately addressed in assessing, planning and governing ES? What are important requirements, factors of success and failure for

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Multi-scale Ecosystem Services Assessment Using Mapping Information - A Case of Hokuriku region level, Ishikawa prefecture level, Kanazawa city level, Japan-

Yoshihiko Iida, UNU-IAS OUIK; Siew Fong Chen, Regional Environmental Planning Inc.; Tadashi Masuzawa, Regional Environmental Planning Inc.; Hajime Ise, Regional Environmental Planning Inc.; Yosuke Amano, UNU-IAS ISI; Wataru Suzuki, UNU-IAS ISI; Tsunao Wa*

Spatial assessment of ecosystem services contributes to understanding the linkages between ecosystem and society. Fine spatial data on ecosystem services is highly useful for policy makers, especially local governments who need to identify and take measures to achieve the sustainable utilization of ecosystem services on site. UNU-IAS OUIK (Operating Unit Ishikawa / Kanazawa, Institute for the Advanced Study of Sustainability, United Nations University) has contributed to establishing Japan's ecosystem services assessment through the Japan Satoyama Satoumi Assessment (JSSA) and its cluster reports including Hokushinetsu regional cluster. In this research, referencing the findings of JSSA, we conducted the multi-scale assessment of ecosystem services using watershed boundaries as structural units at three spatial scales: Hokuriku region, Ishikawa prefecture and Kanazawa city, using public data sources. Assessment maps related to provisioning services, regulating services, cultural services and supporting services were compiled based on the framework of the Millennium Ecosystem Assessment (MEA), visualized from regional to local scale, and carried out spatial overlay to identify ecosystem services hotspots. Though the concept of MEA focused on the relationship between human well-being and ecosystem services, we lack spatial data on social aspects and human well-being, therefore new/updated data together with an integrated approach to understand interactions among different services on human well-being is needed . Capacity building for local policy makers is essential to effectively utilize the findings of the assessments to the planning and implementation in the local context. Discussion on opportunities and future challenges of multi-scale ecosystem assessment was concluded.

Assessing ecological interactions within the crop mosaic using optical and SAR imagery

Julie Betbeder ; LETG Rennes COSTEL, Rennes, France Hubert-Moy Laurence; LETG Rennes COSTEL, Rennes, France Burel Francoise ; CNRS Ecobio, Rennes, France Corgne Samuel ; LETG Rennes COSTEL, Rennes, France Baudry Jacques ; INRA SAD-Paysage, Rennes, France*

The use of remotely sensed data for ecological applications has increased in recent years. We present new opportunities to identify and characterize landscapes at a fine scale with remote sensing data more specifically, we focus on the monitoring of the intra and inter-annual dynamics of vegetation covers using information related to their biophysical properties using optical images or to structural properties using SAR images. Landscape heterogeneity and the amount of semi natural habitats areas have been shown to be major drivers of biodiversity in agricultural landscape. However, little is known on the effect of 1) the intra-annual dynamic of the agricultural mosaic and 2) the interfaces between covers. We tested the hypothesis that interface types and their intra-annual dynamics (i.e. crop phenology) measured at different spatial scales influence directly the intra-annual changes in species composition. We evaluated the potential of indicators (i.e. crop phenology, hedgerow structures) derived from remotely sensed data at two scale -local and landscape scales- to explain the intra-annual dynamic of species composition (carabid beetles) in agricultural landscape. The investigated area is the 'Pleine FougÃ¨res' site of the Long Term Ecological Research zone Armorique, located in France. Carabid beetles were sampled in 45 Maize fields using pitfall traps from April to October 2012. The Maize field plots were chosen to maximize the diversity of local and landscape environments (sparse hedgerows, dense hedgerows, crop interfaces,...). This study shows the high potential of remotely sensed data for modeling biodiversity in agricultural landscapes. At local and landscape scales, intra-annual changes in species composition are higher in field plots surrounding by winter crops than in fields plots surrounding by dense hedgerows (playing a role of barrier). Crops phenology and hedgerows structures detected by SAR imagery explain 40% of the variance of the intra-annual dynamic of carabid beetles in agricultural landscape.

Estimating Inbreeding Rates in Northern Spotted Owls: Insights From Pedigrees and Spatio-Demographic Models

Mark P. Miller, U.S. Geological Survey Forest and Rangeland Ecosystem Science Center; Susan M. Haig, U.S. Geological Survey Forest and Rangeland Ecosystem Science Center, Nathan H. Schumaker, U.S. Environmental Protection Agency; Eric D. Forsman, U.S. Fo*

The federally-threatened Northern Spotted Owl (Strix occidentalis caurina) has a substantial influence on management of federal lands. Despite decades of investigation, important details about its status and habits remain unknown. In particular, determining the frequency of inbreeding may help explain spatial variation in demographic trends. Inbreeding is best estimated using pedigrees, however, multigenerational pedigrees are difficult to establish in long-lived, highly mobile species, as parental and grandparental identities are not always known. We used > 9,500 Northern Spotted Owl hatch records from a ~30 year period to assemble the most comprehensive pedigree available. Despite the volume of data, most individual pedigrees were incomplete. Preliminary estimates of inbreeding derived from pedigrees suggest that 3.14% and 2.9% of the population is highly inbred with inbreeding coefficients of F = 0.25 and F = 0.125, respectively. However, additional analyses of idealized pedigrees revealed that inbreeding rates from incomplete pedigrees overestimate inbreeding as the amount of missing data increases, therefore indicating that they must be considered high upper-bounds estimates. In the absence of unbiased estimates, we turned to a spatio-demographic Northern Spotted Owl simulation implemented in HexSim. Based on simulations, 2.16% (F = 0.25) and 2.01% (F = 0.125) of Northern Spotted Owls are highly inbred. Implications of inbreeding have not been incorporated into demographic models for Northern Spotted Owls. Thus, we discuss remaining challenges that need to be overcome to refine our understanding of demographic trends within the subspecies.

Applying IPCC Representative Concentration Pathway (RCP) land-use projections to a regional level assessment of land-use change in the Pacific Northwest, United States.

Jason T. Sherba, US Geological Survey, Western Geographic Science Center; Benjamin M. Sleeter, US Geological Survey, Western Geographic Science Center*

Incorporating Intergovernmental Panel on Climate Change (IPCC) Representative Concentration Pathway (RCP) land-use projections into regional level land-use models, allows modelers to account for a range of climate and land-use futures at the regional scale. However, when aggregating coarse scale (0.5Â° x 0.5Â°) RCP cell values to create regional land-use transition values, the question of how to properly downscale RCP transition values, for cells overlapping more than one region, inevitably arises. In this study, RCP land-use transition values were downscaled to seven EPA Level III ecoregions in the Pacific Northwest, USA, based on historical land-use transition values from the USGS Land Cover Trends (LCT) dataset. Ecoregion level transition values were then created by summing RCP cell values by ecoregion and RCP land-use transition classes were crosswalked to classes relevant for modeling at regional scales. Ecoregion-level RCP projections were applied as multipliers in a state-and-transition simulation model (STSM) to model land-use change between 2005 and 2100. Resulting RCP-based STSM projections were compared to STSM projections created using two other land-use change datasets: (1) the Special Report on Emissions Scenarios (SRES) dataset; and (2) the USGS LCT dataset. Initial results suggest that downscaled RCP transition values may require expert review before being successfully applied in regional level assessments.

The effects of urbanization and agricultural landscape change on agro-ecosystem services

Ying-Chieh Lee, College of Tourism and Hospitality Management*

The phenomenon of urbanization is one of the major environmental changes today. Due to the mountainous topography in the central and the east, most of the population is concentrated on the western coastal plain of the island of Taiwan. More than one sixth of agricultural land in Taiwan's western plain has been converted to other uses during 1971 to 2006 due to the rapidly developed industry and high population density. The loss of farmland ultimately results in the reduction and degradation not only of its food production function but also of many other agro-ecosystem services. This research focuses on the changes in spatial patterns of agricultural land in the western coastal plain of Taiwan and the effects of agricultural landscape change on agro-ecosystem services. To study how agricultural landscape change affects the sustainability of environment, this research incorporates emergy synthesis to evaluate the changes in ecological energetic flows of agricultural system in each township of the western coastal plain in Taiwan during 1971 and 2006. Landscape metrics and ecological energetic analysis are applied in this research to study the relationship between the change of agricultural landscape and its agro-ecosystem service loss.

Are spatial planning principles and objectives reflected in the evolution of urban landscape patterns? A Romanian - Swiss comparison

Simona R. GrÄfdinaru, Swiss Federal Research Institute of Forest Snow and Landscape - WSL / University of Bucharest, Centre for Environmental Research and Impact Studies; Cristian I. IojÄf, University of Bucharest - Centre for Environmental Research and*

Spatial planning principles and objectives have been recognized as important drivers in shaping settlement development. From development oriented to control oriented, they set the framework for implementing measures that aim at assuring a desired spatial pattern. Our study investigates how planning principles and objectives are reflected in actual development patterns of highly dynamic urban areas. Two sites of approximately 40Â² km were chosen: one in Zurich - Switzerland, and one in Bucharest - Romania, based on the similarity of: land use, functionality of built-up areas, presence of

public green areas and water bodies, relief, and built-up dynamics over time. We developed a framework for a systematic comparison of the two planning systems and practices, and performed the assessment based on four strategies of spatial planning: limitation of built-up expansion, conservation of agricultural land, landscape preservation, and social values. Arial images were used to determine changes over two time steps (2005-2013 for Romania and 2003-2012 for Switzerland), and landscape metrics to subsequently quantify them. Then, a spatial multi-criteria analysis was performed, in order to assess how efficiently planning principles and objectives had been implemented in the two countries. The findings bring a better understanding of how planning could improve urban sustainability.

Desertification in West Siberia: Identification and model of processes for the Northern Kulunda steppe

Vera Schreiner, Institut fur Geographie, University of Leipzig

The problem of desertification is one of the most significant environmental problems investigated since the 1970s. Their factors are not investigated in detail for the dry sub humid regions in Russian Western Siberia. The climatic and human causes and driving factors are strongly linked together and therefore a complex of factors is described using an indicator system. As the principal cause for the start of desertification, the conversion of the land cover from steppe to arable land and the intensification of land use in the middle of last century was identified. Compared to the period of 1951-1964 and actual data, a precipitation increase by 21% and an average increase of the yearly mean temperature by ca. 0.4Â°C/10 years was found. A complex region-specific indicator system has been developed. It includes bio-physical factors for the localisation of indicators of landscape degradation (morpho-dynamic, pedologic, hydrologic, hydro-geologic and bio-indicators) and also socio-economic indicators of the desertification processes using modified scientific approaches first developed by Mensching (1990) and Ibrahim (1992). The results show complex interlinkages between the landscape degradation processes. The analysis also suggests a Dust-Bowl-Syndrome caused by agriculture and a network of social processes comparable with the Sahel-Syndrome - and therefore clear signals for desertification. Causal factors are used to clarify the determinants linking the analysis of 30 selected indicators. Results were used to develop a process model for temporal aspects of the landscape desertification process. The results are usable for the development of prevention and remediation measures.

Black bear damage in western Oregon: an analysis of landscape-level impacts

Kristina Kline, Oregon State University, Department of Forest Ecosystems and Society; Anita T. Morzillo, University of Connecticut, Department of Natural Resources and the Environment; Jimmy Taylor, National Wildlife Research Center, Oregon Field Station*

Disturbance among industrial timberlands creates spatial heterogeneity in landscapes where managers desire a relatively homogenous forest structure. Black bears (Ursus americanus) contribute to disturbance when they emerge from dens and feed on mature conifers by stripping bark and consuming sugar rich vascular tissues. This results in direct loss and degraded log quality of timber. Therefore, there is incentive to better understand relationships between bear damage and forest characteristics at the landscape level. Based on annual aerial damage surveys, we employed a ground based stratified random sampling design in select industrial forests within western Oregon. To date, seven percent of stands sampled (n = 56) contained bear peeling as the primary damage agent. However, 13 percent contained bear peeling and root disease, and 79 percent contained root disease only. In the most heavily bear damaged stand, 17 percent of trees were damaged, whereas damage among all other stands was less than four percent of trees. Almost all bear damaged stands ranged in age from 23-34 years. Seventy percent of bear damaged stands had tree densities of less than 890 trees per hectare. Half of the bear damaged stands contained recent damage from the past two years, whereas the remaining contained

damage more than two years old. Additional ground-truthing data will be used to further inform growth models and refine damage estimates. Results will be used to inform a regional economic model in order to estimate economic loss to timberlands from bear damage at multiple spatial scales.

Changes in distribution pattern of functional group responding to the global change in alpine tundra, Changbai Mountain

Xu Jiawei, Northeast Normal University; Jin Yinghua, Northeast Normal University; Zong Shengwei, Northeast Normal University.

Alpine tundra in the Changbai Mountains located at the humid areas in eastern China, which is a sensitive region responding to climate change. Subtle changes in climate may result in great changes in vegetation of alpine tundra. During the past 50 years, alpine tundra of the Changbai Mountains experienced great changes including temperature raise, accumulated temperature increment, growing season length extend, precipitation increment with intensity increasing, snowpack reduction, snowmelt period shorten, and nitrogen deposition increment. Based on the survey data of 30 years' monitor work, through 4 years' simulated experiments of climate warming, atmospheric nitrogen addition, snowmelt period change, and vegetation cover change, we obtained the discipline of changes in distribution pattern of plant functional group in the alpine tundra under the background of global climate warming. The effects of global change on the alpine tundra were determined as follows: climate warming (CW), snowmelt period shorten (SPS), nitrogen addition (NA), and water erosion caused by frequent heavy rains (WRbR), and divided into two types: multi-effect and mono-effect, which was attributed to the expansion of herb plants, such as Deyeuxia angustifolia, Sanguisorba officinalis, Veratrum oxysepalum, Geranium wilfordii, Bupleurum euphorbioides, Aconitum carmichaeli, etc. Changes in distribution pattern of the functional group represented by D. angustifolia were affected by CW, SPS, NA, and WRbR. Changes in distribution pattern of the functional group represented by S. officinalis were affected by CW, SPS, and WRbR. Changes in distribution pattern of the functional group represented by V. oxysepalum were affected by SPS. Changes in distribution pattern of the functional group represented by G. wilfordii were affected by WRbR. Changes in distribution pattern of the functional group represented by B. euphorbioides were affected by CW and WRbR. Changes in distribution pattern of the functional group represented by A. carmichaeli were affected by CW.

The Upper Mississippi River Floodscape: Spatial Patterns of Flood Inundation And Associated Plant Community Distributions

*Jason J. Rohweder *; Nathan R. De Jager; Yao Yin; Erin Hoy USGS Upper Midwest Environmental Sciences Center*

Although variation in flood inundation is often considered to be the main driver of spatial patterns in floodplain plant communities, few studies have quantified flood-vegetation relationships at broad scales. We integrated 30-years of daily river stage data, high resolution elevation data (lidar), and photo-interpreted vegetation maps to characterize spatial patterns in growing season flood duration and associated plant distributions. A 'floodscape' map was produced, representing mean growing season flood inundation duration for 38,419 ha of floodplain that span 320 km of the Upper Mississippi River (UMR) and used to quantify flood-vegetation relationships for 17 different remotely sensed plant communities. In some areas, very small differences in floodplain elevation (~2 meters) corresponded with surprisingly large differences in mean growing season flood duration (~180 days). Models fit to the cumulative frequency of occurrence of different vegetation types as a function of flood duration showed that most types exist along a continuum of flood-related occurrence. Community distributions supported the Intermediate Disturbance Hypothesis (IDH) in that 1) vegetation communities were

spatially patchy, and 2) species with better dispersal abilities were located in areas with longer flood durations, while those with better competitive abilities were located in areas with shorter flood durations. Quantification of inundation patterns at such large scales should help to identify targets for restoration of historical hydrological regimes or better anticipate hydro-ecological effects of climate change at broad scales.

Soft Forecasts as an Alternative to Land Cover Change Scenarios: Techniques for Development and Assessment

Ron Eastman, Clark Labs*

Land cover change models typically produce a scenario output for some future date - a map of the expected land cover. However, when compared with actual change, the spatial skill of these forecasts is commonly quite low. The reasons can be many, including non-stationarity in the driving forces of change and poor model formulation. However, by reserving a portion of the training data for validation, it can be shown that a major contributor is the indeterminacy of the outcome - at any moment in history there are usually multiple plausible outcomes at a future date. In this context, a hard scenario is of questionable utility and a more useful product may be a soft prediction which expresses the potential of the land to experience specific transitions. Soft predictions can be expressed in several forms, including posterior probabilities and fuzzy measures. Techniques for the development and assessment of soft forecasts are explored through a case study.

Coupling Conservation Action Planning and Marxan to identify a Landscape Conservation Design in the Columbia Plateau Ecoregion

Madeline Steele, USFWS/SWCA; Tom Miewald, USFWS; Sonia A. Hall, SAH Ecologia LLC*

The Arid Lands Initiative (ALI), an assemblage of public, private, and nongovernmental organizations, was convened to develop and implement a coordinated conservation strategy for the Columbia Plateau. A major component of this ongoing effort involved mapping shared conservation priority areas. We used Marxan and based model inputs on a pre-existing Conservation Action Planning (CAP) process. In the CAP, the ALI partners had agreed on biological priorities and identified Key Ecological Attributes (KEAs) that describe each target's viability. For each KEA, they selected quantifiable indicators, and identified thresholds that distinguished between poor, fair, good, and very good condition. To translate this CAP viability analysis into a Marxan assessment, we used "stacked" Marxan targets. In this approach, the entire distribution of an ecosystem is targeted by Marxan, but subsets of that area that satisfy additional KEA thresholds are targeted again. For example, the entire shrub steppe system was one Marxan target, and patches of shrub steppe exceeding 500 acres (threshold for "good" category) were treated as an additional target. With such a configuration, Marxan will typically meet its goals in areas that score well based on multiple KEA indicators, but can also select lower integrity areas if needed to satisfy overall goals. Defining targets and goals based on indicators that reflect the ecological integrity of ecosystems and species differs from the traditional use of Marxan models, and better aligns with current trends in landscape design. The resulting prioritization has been embraced by the ALI, and is being used to inform management.

Trade-offs and synergies among ecosystem services and biodiversity under different forest management scenarios - case study of a forest landscape in southern Sweden

Xi Pang, Ulla Mortberg, Eva-Maria Nordstrom, Hannes Bottcher and Ola Sallnas*

Biodiversity is declining due to loss, fragmentation and degradation of habitat, which undermines ecosystem functioning and therefore threatens also the ability of ecosystems to supply ecosystem services. Moreover, there is a need for adapting to climate change as well as securing the supply of energy, which have led to a shift in energy consumption from fossil fuel to renewables, especially biomass, which in turn put increasing pressure on ecosystems and biodiversity. In Sweden, forest bioenergy has an important role, and high forest biomass production is an important societal objective. However, due to negative effects on natural forest structures and processes, a more intensive forestry could be detrimental to forest biodiversity. The balance between energy demand and the long-term capacity of ecosystems to supply goods and services as well as supporting biodiversity is therefore crucial. The aim of this project was to develop and test methods for integrated sustainability assessment of forest biomass extraction for bioenergy purposes by incorporating effects on biodiversity components and important ecosystem services in the assessment. The landscape simulator LANDSIM was used to model forest growth under two management scenarios, business-as-usual (BAU) and continuous-cover-forestry (CCF), in a time period between 2010-2110. The GIS-based approaches for assessment of impacts on biodiversity and ecosystem services involved an ecological network assessment (ENA) of prioritized ecological profiles, as well as assessment of selected ecosystem services of the landscape. The results of trade-offs and synergies were shown directly in the final comparison under the two scenarios.

Scale issues in planning and policy for ecosystem services: an analytical framework and application in the case of bioenergy trade-offs

Christian Albert, Leibniz Universitat Hannover & Helmholtz Centre for Environmental Research - UFZ; Christina von Haaren, Leibniz Universitat Hannover; Frank Othengrafen, Leibniz Universitat Hannover; Sebastian Kratzig, Leibniz Universitat Hannover; Wiebk

Effective planning and policy making for ecosystem services (ES) is not only challenged by trade-offs between services' provision and conflicts among policies aiming at enhancing individual services, but also by the problem of scale. The objective of this contribution is to introduce a framework for the systematic analysis of scale issues in ES governance, and to illustrate the application of this framework in a case study of bioenergy production. The research questions are: (i) How can the concepts of scale be integrated in an assessment of ES governance? (ii) Which scale effects can be identified in an exemplary case study analysis of bioenergy governance? Building upon the DPSIR (driving forces, pressures, state, impacts, responses) model, a framework for systematically assessing scale effects in ES governance is developed and applied in a nested case study in the region of Hannover, Germany. The case study for the first time spatially illustrates scale effects in ES trade-offs and policy conflicts. The results advance the theory of multilevel governance of ES with a differentiated typology of scale effects and their spatial implications within DPSIR. The suggested approach supports ex-post and ex-ante assessments in policy- and decision-making, and helps actors considering across-level impacts of policy options in practice.

Landscape Pattern and Change By Integration of Remote Sensing and Stonewall Feature Identification

Rebecca Trueman, University of Rhode Island, Yeqiao Wang, University of Rhode Island*

Stone walls are relics of an historical agricultural civilization that once flourished. With the spatial identification of stone walls, landscape compositions of post-agricultural landscapes common across New England and adjacent areas can be assessed with inclusion of human-land use interactions. This research selected the town of New Shoreham, known as Block Island, located 9.4 miles south of the Rhode Island mainland as the study area. Block Island has extensive networks of stonewalls visible to the human eye within the acquired 0.5 foot resolution orthophotography. With analysis of the spatio-

temporal record of imagery, spatial locations of stone walls were extracted to create a standalone dataset containing 129 miles of wall. Additionally, land cover classification data were compiled and standardized to quantify land cover change for the available time period. Determined pattern and presence of stone walls were integrated with temporal land cover classifications, spatial land cover pattern and magnitude of change for both a visual and quantitative assessment. Stone walls represent a human component, among the many accepted factors which generate the composition of landscape mosaics. It is evident that stone walls continue to influence boundaries of land cover, land use and land ownership. By utilizing abilities of GIS technologies to identify stone walls for a large geographic area, this research adds justification to continue the integration of remote sensing technologies and human's cultural histories in studying the forces of land cover change.

Symposium Introduction

Bronwyn Price, Swiss Federal Research Institute WSL; Felix Kienast, Swiss Federal Research Institute WSL; Irmi Seidl, Swiss Federal Research Institute WSL; Peter H. Verburg, VU University Amsterdam; Christian Ginzler, Swiss Federal Research Institute WSL;

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What is the extent of urban sprawl in Europe? A multi-scale analysis of a continent

Jochen A.G. Jaeger, Concordia University Montreal; Tomas Soukup, GISAT Prague and European Topic Center of Land Use and Spatial Information (ETC LUSI); Erika Orlitova, GISAT Prague and European Topic Center of Land Use and Spatial Information (ETC LUSI);*

Increases in urban sprawl are in contradiction to the principles and the spirit of sustainability. Data on the degree of urban sprawl are needed for the performance evaluation of measures intended to limit urban sprawl. We applied the method of "Weighted Urban Proliferation" (WUP) to quantify urban sprawl in 32 countries in Europe, based on the European HRL Imperviousness data sets of 2006 and 2009. The WUP is a combination of the amount of built-up area, its spatial dispersion, and the land uptake per inhabitant or job. We present results at three spatial scales: countries, NUTS-2 regions, and 1 km2 raster grid. Large parts of Europe are affected by urban sprawl. The overall value of WUP in Europe is 1.57 UPU/m2, but the values for the countries cover a large range from very low values in Iceland and the Scandinavian countries (< 1 UPU/m2) to very high values in the Benelux countries (> 6 UPU/m2). Countries of high sprawl levels include those located in the center of Europe, the UK and Portugal. This is the first analysis of urban sprawl and its current rate of increase for an entire continent. It shows how urban sprawl can be monitored for a continent and perhaps even globally. The project is based on a partnership between the European Environment Agency (EEA) and the Swiss Federal Office of the Environment (FOEN), and the results are aimed at scientists, regional planners, decision makers and policy makers, and the general public.

Influence of landscape structure on the carbon stock of tropical forests

Jomar Magalhaes Barbosa, Carnegie Institution for Science*

The deforestation in the tropics has produced landscapes with diversified and complex configuration. As a consequence, large extensions of remaining forests are located within areas affected by edge effect. The impacts of edge-mediated dynamics on key forest processes, including above-ground biomass and carbon storage (AGB), remain poorly characterized in landscapes with complex configuration, as well for different spatial scales. Here, we used data from two tropical regions, Atlantic forest (Brazil) and Hawaiian tropical forests (US), to investigate how landscape configuration affects directly or indirectly

forest structure and carbon stock. In both Brazil and Hawaii, tree height decreased as fragment size reduced, indicating a potential edge effect influence on the forest carbon storage. Analyzing LiDAR data collected in Hawaii from forest patches created by lava flow more than 130 years ago, additive edge effect (from multiple borders) showed a clear influence on different forest structure variables. However, in Atlantic forest, ecological processes determining forest carbon stock are highly heterogeneous and complex, due historical anthropogenic influence, steep slopes, selective logging, and livestock use of forest patches. Forest structure and biomass showed highly heterogeneous distribution within host fragments and landscapes, indicating that local and large scales processes play a crucial role in the relationship between landscape structure and the maintenance of carbon stocks.

Evidence of high-severity fire in historical inventory of fire-prone forests

Keala Hagmann, School of Environmental and Forest Sciences, University of Washington; Jerry F. Franklin, School of Environmental and Forest Sciences, University of Washington.*

Fire is an integral component of socio-ecosystems in the Intermountain Region of western North America to which both forests and people have adapted. Frequent fire historically regulated tree density and maintained structural heterogeneity at multiple spatial scales. Landscape-level timber inventories conducted 90 years ago across hundreds of thousands of forested hectares provide detailed records of variability in the structure and composition of fire-prone forests east of the Cascade Range in Oregon. More than 20% of the area in ~200,000 ha of mixed-conifer and ponderosa pine forests was sampled in systematic strip cruises tied to a grid of documented survey points. Cruisers tallied live conifers at least 15 cm dbh by species and diameter. The ubiquitous presence and abundance of large trees and ponderosa pine in all size classes supports an inference of a predominantly low- to moderate-severity fire regime with limited high-severity fire. Inventoried area overlaps a 1918 fire of ~80,000 ha in ponderosa pine-lodgepole pine forests and also includes high-severity burn patches in hemlock-fir forests with huckleberry understory. Large, treeless openings, which might result from high-severity disturbance, were recorded only in lodgepole pine stands within the perimeter of an extensive fire and in burned areas in the transition to wetter, colder forest. The absence of stands composed solely of small-diameter trees provides further evidence that high-severity wildfires with an extensive stand-replacement component were either absent or uncommon. Uncharacteristically severe fires in these fire-prone environments may jeopardize characteristic functions and our capacity to manage for desired services.

Spatial scaling concepts as applied to the assessment and restoration of drylands

Brandon Bestelmeyer, USDA-ARS Jornada Experimental Range

Scaling concepts are important because they induce people to think about processes and relationships that might otherwise be overlooked. For land management-related activities, the challenge is to incorporate scaling concepts into routine observation, evaluation, and planning. Drawing on experiences trying to incorporate ecological science into land management planning in drylands, I suggest that three basic scaling principles are becoming common knowledge (and sometimes conventional wisdom). 1) 'The whole is greater than the sum of its parts': The arrangement of distinct land areas within a patch or landscape mosaic can produce emergent properties as a consequence of spatial interactions among adjacent land areas. 2) 'Location matters': Spatial context provided by the landscape can influence the properties of specific locations. 3) 'How (not to) lie with maps': the results of analyses conducted using geographic information systems software depend on the rules by which the map was produced and how the mapped units are interpreted. I will illustrate the importance of these principles for dryland

management using examples and discuss how we might better incorporate the principles into routine management activities.

Using LiDAR for Multi-scale Restoration of Forest Structure and Pattern

Derek J Churchill, University of Washington Van Kane, University of Washington Robert McGaughey, Pacific Northwest Research Station Jonathan Kane, University of Washington Sean Jeronimo, University of Washington*

Increasing the resilience and adaptive capacity of fire-prone ecosystems in the Western US requires managing for desired patterns of forest structure and composition across multiple scales. Currently, our ability to restore resilient patterns that also sustain key wildlife species is limited by lack of accurate and scalable inventory data. Airborne LiDAR provides high-resolution measurements of forest structure over large spatial extents. However, the development of tools to use LiDAR data in management has lagged behind the data collection itself. While much work has gone into deriving inventory metrics such as basal area and biomass, methods that utilize the full potential of LiDAR are still in their infancy. We present a set of LiDAR-based tools and metrics that quantify horizontal and vertical patterns of forest structure at multiple scales. At the stand level, we use LiDAR information to identify and classify patterns of individual trees, clumps, and openings. Across catchments and watersheds, we use a raster based structural classification to derive landscape metrics. We present case studies from the Sierra Nevada and Northeast Washington that demonstrate use of these tools in: characterizing reference conditions from active fire regime sites, quantifying habitat at a variety of spatial scales, developing prescriptions to create clump/gap patterns, and monitoring changes in patterns of forest structure from restoration treatments. We also discuss how these tools are increasing the ability of managers and stakeholders to design and monitor treatments that build social support for restoration.

Complex edge effects in forest patches surrounded by varying development intensities

Doreen E. Davis, University of North Carolina at Charlotte; Sara A. Gagne, University of North Carolina at Charlotte*

Forests in urbanizing landscapes become dominated by edge habitat, impacting the distribution of wildlife. Until recently, edge effects research has been characterized by subjective comparisons of edge and interior habitats, an assumption of linear responses, and little consideration of landscape context that have limited the development of the field. Here, we build on advances in ground beetle research by using triangulation wombling to identify boundaries in beetle community structure at the developed edges of forest patches in landscapes of varying urban intensities. We hypothesized that marked discontinuities in structure between maintained yards and forest would engender boundaries in environmental variables and beetle community composition at edges between nature preserves and residential developments. We also expected that the edge of a forest patch with a more urbanized context would exhibit weaker boundary structure because of an overall greater degree of disturbance in the patch. We collected beetles in 200 by 200 m trapping grids centered at the edges of patches with a rural, suburban, or urban context. Contrary to our expectations, boundaries did not correspond to the physical edges of forests with yards. Rather, many areas of abrupt change were located throughout the forest and development. This pattern was magnified at the urban patch edge, indicating greater environmental heterogeneity as a result of more disturbance. Increasing urbanization surrounding patches also dampened beetle edge responses, as predicted. Our results demonstrate the utility of boundary detection to reveal the complexity of edge effects in urbanizing landscapes.

Modeling Status, Trends, and Uncertainty of Native Pollinators across the U.S.

IALE WORLD CONGRESS 2015 – TECHNICAL PRESENTATION ABSTRACTS

Insu Koh, University of Vermont; Eric V. Lonsdorf, Frank & Marshall College; Claire Brittain, University of California Davis; Neal M. Williams, University of California Davis; Rufus Issacs, Michigan State University; Taylor H. Ricketts, University of Verm

Native bees are important pollinators and provide efficient pollination services for many crops. Their populations are largely determined by the spatial distribution of nesting and floral resources. While most studies of native bee population occur at landscape or farm scales, the White House has recently called for a national assessment of native pollinators. Such an assessment can point to general trends and identify spatial priorities for research and conservation but it will be challenging because of increased uncertainty in the evaluation of habitat resources. To examine the spatial and temporal patterns of native bee abundance and the consequences of uncertainty at the U.S. national scale, we used expert opinion and a spatially explicit pollination model that predicts relative pollinator abundance based on a distance-weighted measure of foraging resources. We evaluated resource availability for representative land-uses from croplands to natural areas and quantified the uncertainty by constructing probability distributions. Then we used Monte Carlo simulation and validated the model with field-measured abundance data in several states. Using 2008 and 2013 National Cropland Data Layers we mapped native pollinator abundance and its uncertainty. We found both abundance and uncertainty increased mostly in eastern forested regions and desert shrub lands. Abundance decreased largely where dramatic land-use changes occurred in most of Midwestern states. A total 32 counties had shortage of native pollinator supply compared to crop demand. These results and approaches will help to inform management and policy decisions for native bees at the national level.