

# 40<sup>th</sup> Anniversary Conference

Gesellschaft für

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Book of Abstracts

August 30<sup>th</sup> to September 03<sup>rd</sup>, 2010



**ECOLOGICAL SOCIETY OF GERMANY, AUSTRIA AND  
SWITZERLAND**

**40<sup>th</sup> Anniversary Conference**

**“The Future of Biodiversity:  
Genes, Species, Ecosystems”**

**Justus-Liebig-University Giessen**

**30<sup>th</sup> August – 03<sup>rd</sup> September 2010**

**Book of Abstracts**

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## **Verhandlungen der Gesellschaft für Ökologie, Band 40**

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The 40<sup>th</sup> Anniversary Conference of the Ecological Society of Germany, Austria and Switzerland (GfÖ) is taking place from 30<sup>th</sup> August to 03<sup>th</sup> September 2010 at the Justus Liebig University in Giessen. Host of the Conference is the Department of Animal Ecology.

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**Grußwort**

**anlässlich der 40. Jahrestagung der Gesellschaft für Ökologie (GrÖ)**

Allen Teilnehmerinnen und Teilnehmern der 40. Jahrestagung der Gesellschaft für Ökologie übermittle ich herzliche Grüße.

„Die Zukunft der Biodiversität“ - unter Ihrem diesjährigen Tagungsmotto nehmen Sie nicht weniger als wesentliche Grundlagen für menschliches Leben und Wirtschaften in den Blick. In der Tat birgt die Vielfalt von Lebensräumen, Arten und Genen Antworten auf unzählige wissenschaftliche Fragen und den Schlüssel für innovative medizinische und technische Lösungen.

Doch der unschätzbare Reichtum der biologischen Vielfalt ist durch den Klimawandel und die Ansprüche einer wachsenden Weltbevölkerung gefährdet. Das internationale Ziel, bis zum Jahr 2010 zumindest die Geschwindigkeit des Artensterbens zu verringern, wurde nicht erreicht. Nach wie vor gehen uns Arten in dramatischem Ausmaß unwiederbringlich verloren.

Immerhin gibt es positive Anzeichen für eine Trendwende. Weltweit setzt sich immer stärker die Erkenntnis durch, dass Klimaschutz, der Schutz von Lebensräumen und deren nachhaltige Nutzung untrennbar miteinander verbunden sind. Mit dieser Überzeugung geht die Erfahrung einher, wie sehr es sich lohnt, in den Erhalt von Arten und Ökosystemen zu investieren.

Ein hinreichender Schutz der großen Lebensräume - seien es die Regenwälder oder zum Beispiel die Weltmeere - kann nur durch gemeinsame Anstrengungen der Staatengemeinschaft gelingen. Deshalb begrüße ich, dass die Vereinten Nationen das Jahr 2010 zum Internationalen Jahr der Biologischen Vielfalt ausgerufen haben. Dies verstehe ich nicht zuletzt als Appell an die Politik. Doch der globalen Querschnittsaufgabe, biologische Vielfalt zu bewahren, ist Politik allein nicht gewachsen. Sie ist auf Unterstützung angewiesen - insbesondere seitens der Wissenschaft.

Deutschland hat sich mit anderen Staaten erfolgreich dafür eingesetzt, dass es mit der IPBES, der Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, eine internationale Schnittstelle zwischen Politik und Wissenschaft geben wird. Ich bin auch der Gesellschaft für Ökologie dankbar für ihre wichtigen Beiträge, mit denen sie den Dialog zwischen Wissenschaft und Politik bereichert.

Denn noch immer wissen wir viel zu wenig über die Funktionsweise der Ökosysteme, die uns Tag für Tag mit Luft, Wasser und Nahrung versorgen. Es ist dringend erforderlich, diese lebenswichtigen Zusammenhänge weiter auszuleuchten. Nur so können wir abschätzen, welche tatsächlichen Kosten unsere Lebensweisen verursachen. Nur so können wir überprüfen, ob unsere Maßnahmen zur Erhaltung der Biodiversität greifen und welche weiteren Maßnahmen notwendig und zielführend sind.

Deshalb sind auch mit der diesjährigen Tagung der Gesellschaft für Ökologie wieder hohe Erwartungen verbunden. Ich bin mir sicher, dass die hier in Gießen vorgestellten und diskutierten wissenschaftlichen Arbeiten Aufschluss über aussichtsreiche Gestaltungsmöglichkeiten des Lebensraumschutzes der nächsten Jahre geben werden.

In diesem Jahr des 40-jährigen Bestehens der Gesellschaft für Ökologie richte ich einen ganz besonderen Gruß an ihre Gründerin: Frau Professorin Lore Steubing. Früher als viele andere hat sie erkannt, wie wichtig es ist, ökologische Fragen als internationale Fragen zu behandeln, um viel versprechende Lösungswege erschließen zu können. So hat sie jahrzehntelang den wissenschaftlichen Austausch über Landesgrenzen hinweg gefördert und für Generationen von Ökologen Maßstäbe in Forschung und Lehre gesetzt. Diese Tagung mit Teilnehmern aus der ganzen Welt ist ein schöner und passender Rahmen, um ihr Lebenswerk als international renommierte Wissenschaftlerin zu würdigen.

40 Jahre Gesellschaft für Ökologie - dieses Jubiläum ist nicht nur eine Reminiszenz an zurückliegende erfolgreiche Wissenschaftsjahre. Es birgt auch den Anspruch, weiterhin Zukunft mit zu gestalten. In diesem Sinne wünsche ich der Gesellschaft für Ökologie eine gelungene Jubiläumstagung und allen Teilnehmern anregende und Gewinn bringende Diskussionen.

Corine Kurz



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Dear friends and colleagues,

I am pleased to welcome you at the 40<sup>th</sup> Annual Meeting of the Ecological Society of Germany, Austria & Switzerland (GfÖ) taking place at my home university: the Justus-Liebig-University of Giessen. Our motto "*The Future of Biodiversity – Genes, Species, Ecosystems*" highlights our willingness for approaching the most challenging issues of ecological research and nature conservation. This is also impressively emphasized by Dr. Angela Merkel, Bundeskanzlerin der Bundesrepublik Deutschland, in the greetings she has send to us. We are grateful for her thoughtful words and for her compliance to support the many efforts of the ecological community to protect the biological richness of our planet.

In this year we will celebrate the 40<sup>th</sup> anniversary of the GfÖ. As I have mentioned before, we actually celebrate the birth of a great idea, since the inscription of our society into the forms of the district court took place a little bit later. However, I consider the birth of an idea to be much more exciting than its official record. I am thus proud to say that the idea of establishing an ecological society as a platform for bringing together people working in the fields of environmental research and nature conservation within the German speaking countries was born 40 years ago at the Justus-Liebig-University. Started by a small number of young and visionary scientists meeting here in Giessen, this initiative became enormously successful: the GfÖ now ranks among the biggest societies for scientific ecology worldwide. I am particularly delighted by the fact that the first president of our society, Prof. Dr. Dr. h.c. Lore Steubing, joins us during this meeting, giving us the chance to learn from the past for approaching the future. I particularly encourage the many young attendees to use this unique opportunity.

The Giessen University ("Ludoviciana" or "Ludwigs-Universität," since the end of the Second World War "Justus-Liebig-University") is one of the older universities in the German-speaking part of Europe and celebrated its 400th anniversary in 2007. As a result of religious and philosophical differences at Marburg, which turned Calvinist, the members of staff who remained loyal to the Lutheran faith moved to the nearby city of Giessen in 1607, where Landgrave Ludwig V of Hessen-Darmstadt had created a new university. The Ludoviciana played an important role in several of major scientific discoveries. Some of the pioneers were the chemist Justus Liebig (inventor of artificial fertilizers and much more), the physicist Wilhelm Conrad Röntgen (father of X-rays and winner of the first Nobel Prize for physics), the botanist Herrmann Hoffmann (regular correspondent of Darwin and one of the inventors of meteorological-phenological research) and the zoologist Carl Vogt (explicitly mentioned by Darwin as one of the supporters for the theory of evolution and a left-winged representative in the Frankfurt Parliament). Today, the Justus-Liebig-University is a modern academic institution hosting almost 25.000 Students and app. 4.000 employees. The JLU is a comprehensive university, which is a particularly devoted to life-sciences and cultural studies. Its close and long-

lasting link to biodiversity issues is not least documented by the fact that the JLU runs the oldest botanical garden of Germany, which is still located at the place of its foundation. Today, the wonderful garden is actively used for groundbreaking research and the presidium of our university has just decided to generously support its future development as an important and widely visible contribution of the JLU to research on biological diversity.

I wish us a productive and communicative meeting in the friendly and stimulating atmosphere of Giessen.

Volkmar Wolters

President of the GfÖ

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Jorge A. Encarnação & Uwe Kierdorf – **German Session**



# Keynote speakers



## **PROF. DR. ANTJE BOETIUS**

### **Ecology and sustainability of the ocean – How to know the unknown**

*Antje Boetius*<sup>1</sup>

<sup>1</sup> HGF MPG Research Group on Deep Sea Ecology and Technology, Alfred Wegener Institute for Polar and Marine Research

This presentation summarizes recent discoveries of ocean life and habitats, and new methods in ecosystem studies from the shoreline to the abyss. The past ten years of ocean observation and census of marine life have improved our ability to study and explain the dynamics of diversity, distribution, and abundance of marine species in a multitude of ocean ecosystems. Records of ocean life and ecosystem functions provide the necessary baseline information to develop scenarios of the future ocean, and ongoing observations of biology and biodiversity in the oceans are crucial for understanding and mitigating problems in the marine ecosystem. Nevertheless, we are only at the beginning to explore the enormous diversity of life in the ocean and its many functions and services. Facing a dramatic overexploitation of fish stocks, the threat of giant oil spills, the rapid retreat of sea ice in the polar realms, and other problems connected to human interaction with the ocean and climate, basic research on understanding ecosystem responses to ocean impacts and perturbations becomes an urgent societal issue. Hence, ocean ecology needs a much higher level of attention in programs for nature conservation and sustainable management.



## **PROF. DR. ANDREAS FANGMEIER**

### **About climate change in 30 minutes**

*Andreas Fangmeier*<sup>1</sup>

<sup>1</sup> Institute for Landscape and Plant Ecology, University of Hohenheim

Climate change is concerning any aspect of the earth system, ecosystem functioning, ecosystem services and human wellbeing. A 30 minute talk will therefore not be able to provide anything that might be called comprehensive information. Only marginally covering mainstream knowledge, the talk will nevertheless elucidate some subtle but potentially important aspects of climate change impacts. I will start with some statements on the current acceptance of the idea of anthropogenic climate change. A major section of the talk will be devoted to agriculture. The role of climate change as driver for the origin of agriculture will be considered as well as expected changes in crop yield in relation to current overall development and progress in agriculture. Furthermore, subtle effects of climate change such as potential effects on yield quality will be presented. Case studies will show potential effects on ecosystem carbon cycling and on the hydrological cycle. And, since the 40<sup>th</sup> anniversary of the GfÖ is on “The Future of Biodiversity - Genes, Species, Ecosystems”, some basic thoughts on climate change impacts on biodiversity will also be presented. Finally, I will critically highlight the options and restrictions in methodological approaches currently available to investigate the expected changes. This will involve some remarks on scales.



**PROF. DR. IZUMI WASHITANI****Biodiversity assessment and participatory biodiversity monitoring in Japan***Izumi Washitani*<sup>1</sup><sup>1</sup> University of Tokyo

There is growing interest and involvement in assessment and monitoring of biodiversity among Japanese ecologists. A recent major activity that aims to provide ecological information to support policy development was the compilation of the “Japan Biodiversity Outlook (JBO)”, a comprehensive assessment of biodiversity in Japan. JBO was prepared by the “Japan Biodiversity Outlook Science Committee”, organized by the Natural Environment Bureau of the Ministry of the Environment. The committee consists of a number of scientists covering a wide range of research areas in ecology and related sciences. JBO was designed to meet three main targets: to assess the loss of biodiversity in Japan; to raise the awareness of the state of biodiversity; to provide the administration with the information necessary to make policy decisions related to biodiversity. The assessment covered the time period from the mid-1950s to the present. Japanese biodiversity was assessed using 30 indicators and 104 data sets to measure the drivers of biodiversity loss and the current state of biodiversity along the six ecosystem types: “Forest and Mountain Systems”, “Cultivated Systems”, “Urban Systems”, “Inland Water Systems”, “Marine and Coastal Systems”, and “Island Systems”. The main conclusions are: 1. “Loss of biodiversity as a result of human activities has affected all ecosystems, and the loss is continuing on the whole”, and 2. “The degree of loss of biodiversity has been especially large in Inland Water Systems, Marine and Coastal Systems, and Island Systems”.

The process of compiling the JBO has revealed a conspicuous lack of data on the status of species. In order to collect necessary data for assessment and conservation of biodiversity, participatory monitoring schemes are a highly promising approach. In order to develop a participatory monitoring program as a system to integrate data collection, storage, analysis, and public outreach activities, collaboration between ecological and information sciences in research is essential. I will give a brief overview of such an interdisciplinary research program that is part of the Data Integration and Analysis System (DIAS) programs organized by the “Earth Observation Data Integration and Fusion Research Initiative (EDITORIA)” led by a scientist group at the University of Tokyo.



**ASSOCIATE PROF. DR. CATHERINE GRAHAM****Phylogenetic assemblage structure in tropical hummingbird communities**

*Catherine Graham*<sup>1</sup>, Juan Parra<sup>1</sup>, McGuire Jim<sup>2</sup>

<sup>1</sup> Department of Ecology and Evolution, Stony Brook University, New York

<sup>2</sup> University of California – Berkeley

Community composition is influenced by a myriad of ecological and evolutionary processes that act at different temporal and spatial scales. We assessed how species, traits and phylogenetic composition changed along environmental gradients and across biogeographic barriers using data for 189 hummingbird communities in Ecuador. We identified four regions with non-random representation of phylogenetic lineages: the eastern Amazonian lowlands, the western dry lowlands, and middle and high elevations along the Andes. The environmental gradients along which changes in the representation of lineages occurred were mainly elevation, annual precipitation, and seasonality in both temperature and precipitation. Further, by comparing a compositional and phylogenetic measure of beta-diversity, we found that communities in the lowlands on opposite sides of the Andes tend to be phylogenetically similar despite their large differences in species composition, a pattern implicating the Andes as an important dispersal barrier. In contrast, along the steep environmental gradient between the lowlands and the Andes we found evidence that species turnover is comprised of relatively distantly related species. Evaluating diversity patterns across environmental gradients and biogeographic barriers, provides insight into the potential mechanisms underlying these patterns in one of the most species rich, complex regions of the world.



**PROF. DR. NINA BUCHMANN****Perspectives in ecosystem research: Tools, approaches, open questions**

*Prof. Nina Buchmann*<sup>1</sup>

<sup>1</sup> ETH Zurich, Switzerland

Ecosystem research aims to understand ecosystem functioning across spatial and temporal scales, to identify and quantify processes at the system level, under different environmental conditions, including biotic interactions and feedbacks. Over the last decades, we have seen a tremendous advancement in ecosystem research, not only for single organisms or ecosystem compartments, but also for the whole ecosystem itself. A large part of this advancement leading to new insights can be traced back to the use of new tools and approaches. Good examples are the use of micrometeorological techniques to quantify ecosystem gas exchange *in situ* at high temporal resolution or the application of remote sensing and spectrometry to explore spatial patterns of ecosystem distribution, ecosystem physiology and their changes over time.

Combining innovative with classical approaches, e.g., combining laser spectroscopy for stable isotope analyses with experimental manipulations in the field or under controlled conditions, allows us to gain new insight into plant carbon allocation and the speed of link between above- and belowground processes. Similarly, adding genetic analyses to classical plant community studies at ecosystem and landscape levels helps us to identify mechanisms leading to dispersal and spread of invasive species, beyond identifying plant functional traits.

At the same time, maintaining long-term datasets offers great opportunities to answer future questions, e.g., questions about slowly changing phenomena. Long-term datasets on the phenology of flora and fauna or on the nutrient loads of hydrological systems allows identifying impacts of anthropogenic, environmental or climate change on the biology of organisms and on the state of ecosystems. However, despite keeping such long-term observations, testing and applying new techniques for a similar purpose is the key to scientific progress. For example, adding webcam applications to classical phenological observations offers opportunities to link plant life cycles to net ecosystem CO<sub>2</sub> fluxes to generalize site-specific observations to other sites or to the landscape level.

Thus, we have seen lots of progress over the last decades, but the challenges for ecosystem research are still outstanding: globally, we face complex problems, ranging from overexploitation of natural resources to man-made changes in biogeochemical cycles to climate change. To address these challenges, we need to maintain (and train young scientists in) the classical tools which accelerated ecosystem research in the past, while being open and applying new techniques and approaches which might offer still unexplored opportunities for the future.



## **ASSOCIATE PROF. DR. KATRIONA SHEA**

### **Context-dependent invasion and management of invasive species**

*Katriona Shea*<sup>1</sup>

<sup>1</sup> Department of Biology, Pennsylvania State University

Ecological context affects the success of invasive species, and hence optimal management strategies for their control. Furthermore, optimal control of local abundance and population growth may require different management strategies than optimal control of spatial spread. In this talk, I synthesize field data on an invasive plant species in different parts of its native and invaded range. I use recently developed theory to understand how different and changing ecological and environmental conditions may affect the success of invasive species, and hence the most appropriate management strategy for a biological invasion.



**PROF. DR. GRAEME CUMMING****Network Analysis in Conservation Biogeography***Graeme Cumming*<sup>1</sup><sup>1</sup> Percy Fitz Patrick Institute, University of Cape Town

In southern Africa, water birds must develop strategies that are robust to high levels of spatial and temporal variation in habitat availability. Satellite telemetry data and ringing recoveries suggest that many species are highly mobile. Movement strategies can be explored using genetic algorithms, together with a spatially defined network and appropriate data describing environmental stochasticity. I illustrate the approach using a simple example which suggests that highly mobile, strongly water-dependent birds in South Africa should exhibit seasonal movements between rainfall regions. The duck analysis sets the stage for a broader discussion of network analysis in conservation biogeography. I highlight some recent applications of network analysis in ecology and conservation and then discuss five of the challenges faced by network analysis in conservation biogeography. They include (i) understanding cross-scale and cross-level linkages in ecological systems, (ii) capturing dynamic aspects of ecological systems and networks, (iii) integrating ecological aspects of network theory with metacommunity frameworks and multiple node functions and roles, (iv) integrating the analysis of social and ecological networks and (v) laying an empirical foundation for network analysis in conservation biogeography. This fast-moving and exciting area of ecology promises a range of new and intriguing developments in conservation biogeography.



## **PROF. DR. ELISABETH K. V. KALKO**

### **Protective function of biodiversity**

*Elisabeth K. V. Kalko*<sup>1</sup>

<sup>1</sup>Experimental Ecology, University of Ulm, Germany & Smithsonian Tropical Research Institute, Panama

In my talk I am illustrating current examples how rapid anthropogenic change accelerates reactions in ecosystems, which in turn lead to an ever increasing loss of biodiversity. One example is the rapid spread of diseases such as the global amphibian die-off or the “white nose syndrome”, a fungus infection in bats of North America. Another example concerns the rapid spread of infectious diseases caused by intensification of the contact between wildlife and humans. What causes those changes, what are the consequences and how can causes and consequences be mitigated? First results suggest that systems with higher biodiversity yield better buffer capacities against disease than less diverse, species-poorer systems. Probably, maintenance of species-rich assemblages may increase protective functions for the whole system, one reason more to preserve biodiversity also for future generations.



# Sessions

Oral and poster presentations



## SESSION 01 - DROUGHT, STRESS, VARIABILITY, ADAPTATION: DRYLANDS AS MODEL ECOSYSTEMS

CONVENOR: ANJA LINSTÄDTER, KARSTEN WESCHE

ORAL PRESENTATIONS:

### **The dispersal-dormancy trade off in dryland annuals- Putting model predictions to a test**

*Katja Tielbörger*<sup>1</sup>, Wolfgang Siewert<sup>1</sup>

<sup>1</sup> Plant Ecology, University of Tübingen

Bet-hedging is a means to increase fitness in environments that vary unpredictably in space and time. In such environments, models predict a trade-off between the bet-hedging strategies dispersal and dormancy while the increasing importance of risk-reduction with decreasing predictability should lead to a positive dispersal dormancy relationship between environments. Unfortunately, there has been no experimental study to test these predictions in the field. Here, we used a set of novel field experiments that enabled us to quantify and separate seedling recruitment from three sources: local reproduction, dormancy and dispersal. The study included the entire plant community from five environments differing considerably in predictability. No evidence for the existence of a trade-off between dispersal and dormancy within environments and only little evidence for a positive relationship between environments was found. The importance of dispersal for population and community dynamics in our system was extremely low relative to local reproduction and dormancy. This indicates that the role of dispersal for buffering environmental variation may be negligible compared to other risk-reducing strategies. Our findings highlight the urgent need for multi-species and multi-site experiments in empirical tests of theoretical predictions.



## **Effect of plant-plant interactions on phylogenetic structure of a Mediterranean plant community along an aridity gradient**

*Raúl García Camacho*<sup>1</sup>, Johannes Metz<sup>1</sup>, Katja Tielbörger<sup>1</sup>

<sup>1</sup> Abteilung Vegetationsökologie, Universität Tübingen

The phylogenetic structure of communities has received increased attention the last years. Getting to know the relatedness of species within a community and how it changes under changing conditions gives information about the processes leading to its assemblage. For instance, positive and negative interactions are expected to leave different traces in the phylogenetic structure of plant communities- i.e. assuming more related species to be similar, positive interactions would lead to more phylogenetically overdispersed communities, i.e. species within the community are less related than expected by chance because facilitation occurs between distantly related species. Here we studied the changes in the phylogenetic structure of a plant community along an aridity gradient in Eastern Mediterranean. We hypothesised that increased positive interactions with increasing aridity would lead to more phylogenetically overdispersed communities. Namely, the presence of facilitative shrubs enables species to coexist from which otherwise they would be excluded via abiotic stress, increasing phylogenetic diversity.



## **Vegetation border lines in arid areas depending on topography and surface processes**

*Sarah Christine Sträh*<sup>1</sup>

<sup>1</sup> Departement of Physical Geography, University of Basel

Climate and environmental changes have an important influence on vegetation density and diversity, affecting vegetation patterns that lead to the existence of border lines. Vegetation in arid areas is a product of rainfall, runoff and surface interactions that cause various patterns depending on water supply. This study aims to define vegetation border lines by comparing climatologic and geo ecological drought stress in desert plants of the catchment area near Sede Boqer (Negev desert, Israel). Previous studies tried to explain the effect of morph dynamic variability on runoff processes and vegetation density, by considering the importance of a rocky slope site where rocky patches generate runoff, while soil patches absorb the water. This study investigates more of the surface characteristics that are of importance for eco hydrological processes, trying to explain vegetation density and plant vitality by considering a more precise definition for morphological units in terms of: rock / soil distribution, soil volume, soil surface and eco hydrological aspects. Braun Blanquet vegetation mapping, GIS-methods and statistical tests explain the direction of succession. Plant vitality shows the reaction of ground water supply and adaptability of plants to climate change. It refers to the ability of plants to adjust to the current precipitation situation in the presence of critical soil and surface properties. Spatial and time related processes can be analyzed at a small scale in an arid, morphologic complex shaped area.



**Zonal or azonal? The contribution of termite mounds as microhabitats for the floristic diversity of West Africa Savannas**

Arne Erpenbach<sup>1</sup>, Karen Hahn-Hadjali<sup>1</sup>, Rüdiger Wittig<sup>1</sup>

<sup>1</sup> Department of Ecology and Geobotany, Goethe University Frankfurt

Termites are renowned as ecosystem engineers of tropical ecosystems. Their mounds have been described as supporting distinct vegetation in African savannas. They constitute a spatially and temporally defined microhabitat for several plant species, enriching floristic and structural diversity of savanna vegetation. Notwithstanding their contribution to local diversity, there is a lack of comparative studies between different vegetation zones. Thus, we compare vegetation on termite mounds in protected areas along a climatic transect from the Sahelian zone to the south Soudanian zone in West Africa. We find several plant species being characteristically confined to *Macrotermes* mounds throughout our study area. However, vegetation composition varies along the climatic transect, therefore raising the question to which degree termite mound vegetation is azonal or extrazonal. We suggest that these microhabitats enlarge the ranges of several species to otherwise unsuitable vegetation zones, but nevertheless are subject to a climatic influence. Implications for conservation planning concerning climate change may stand to reason.



## **Plant species responses to grazing and climate manipulations along the Jordan River Valley**

*Mark Bilton*<sup>1</sup>, *Johannes Metz*<sup>1</sup>, *Sara Bangerter*<sup>2</sup>, *Katja Tielbörger*<sup>2</sup>

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Climate change and grazing management could pose a particular threat to plant species in dry environments. Results from two long-term studies (Israel 9 years; Jordan 4 years), which have both been conducted at similar altitudes along steep rainfall gradients, provide an opportunity to compare and contrast manipulations of water availability (control, rain shelters, water addition) and grazing (free grazing, fenced exclosures). Plant distribution ranges, traits and functional approaches are used to form testable predictions of species response to habitat alterations. We test the hypotheses that species in the plant community with a narrow distribution range or at the edge of a distribution range are more susceptible to a changing environment. We further investigate the directional shift of the similar traits involved in drought resistance and grazing tolerance, that raise the possibility that a release of grazing pressure may help buffer some of the effects of climate change.



## **Dryland pastures: How to find indicators in a highly variable system?**

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Fodder resources on dryland pastures are highly variable in space and time. To assess their availability, various ecological indicators are used. They operate on different levels (individuals, populations, species, communities) according to the spatial and temporal scale of application, with implications for their sensitivity. Choosing the appropriate level of indication is still not an easy task. For example, indicators on a high hierarchical level are often loosely coupled to the primary effects which they are intended to detect. This may result in an increased bias. Because of their functional relation to ecosystem processes, Plant Functional Types (PFTs) are frequently used for rangeland assessment. On the community level, aboveground net primary production (ANPP), and rain-use efficiency (RUE) have become important indicators since remote sensing allows to easily access data on large spatial scales. Local Ecological Knowledge is a new indicator which implicitly includes information on several hierarchical levels of plant organisation. We examine the significance of three rangeland indicators (ANPP/RUE, PFTs, and Local Ecological Knowledge) for various levels of natural resource variability. We use a case study from the High Atlas Mountains, Morocco where steep environmental gradients are combined with gradients of land use pressure. We evaluate which type of indicator is best applied for which purpose, and how bias may be reduced.



## **Rain-use efficiency: A concept revisited. Recent challenges and possible approaches**

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In drylands rain-use efficiency (RUE) and aboveground net primary production (ANPP) are two of the most common ecological indicators for assessing ecosystem's state and supply of ecosystem services. Especially where natural variability has to be parted from anthropogenic influences RUE and ANPP are promising tools. These parameters have some major advantages over other ecological indicators: (1) Both are comparatively easy and cheap to collect. (2) Their principal ability to assess ecosystem state has frequently been confirmed. (3) They allow cross-system/-scale comparisons. Despite their widespread and frequent application, both face growing criticism: ANPP and RUE aggregate complex information and have therefore been referred to as 'lumped' parameters. Furthermore after 25 years of research, there is still no consensus about the trend of ANPP and RUE along precipitation gradients, which makes it difficult to extrapolate these parameters in space and time. We used meta-analysis to disentangle the influence of various ecological factors on ANPP & RUE. Their response as function of precipitation was analyzed with linear piecewise quantile regression (LPQR), which revealed a more detailed picture of the relationship of ANPP and RUE to precipitation than linear or exponential regression methods. Results show that ANPP & RUE are significantly affected by precipitation and land-use and that most of their natural variability could be traced back to factors such as biome and soil type.



## **Modelling livestock numbers in the Gobi desert: responses to variation in climate and productivity**

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Discussions in rangeland ecology on the relative importance of biotic vs. abiotic controls have not lost momentum. Here, we assessed the dynamics of livestock numbers in the highly variable drylands of the southern Mongolian Gobi. Herd sizes per year and county were correlated with environmental data. Predictor variables were monthly precipitation data and an 8 day NDVI product as a proxy for biomass productivity in this highly water-controlled system. Data from 15 counties were used covering the period 1985-2006; data analysis was based on mixed models. Political transformation from socialism to capitalism in the mid 1990s triggered a tremendous change in herd size and composition; goat numbers increased due to the relatively high value of cashmere for export. Increasing herd sizes in the 1990s were facilitated by relatively moist conditions. Following pronounced droughts in 2001 – 2002, numbers fell to levels before transformation, and have thereafter recovered during moister years, with goats continuously accounting for a higher share of the herds than before the transformation. Statistical models were highly significant, explaining more than 50% of the variance depending on the examined livestock species. Livestock populations are thus widely driven by precipitation and the associated biomass availability showing that they are strongly controlled by environmental factors. Lasting changes in herd species composition after the 1990s do, however, imply that political developments still have an influence.



## **The role of key resources to ensure sustainable range management – A modeling study**

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Semi-arid grazing systems are prone to ecological change due to rising climate variability, leading to an increased frequency of extreme events, particularly droughts. An adaptive range management needs to focus on ecological factors that enable land users to adjust to increasing climate variability. Until now, the ecological concept of key resources (KR) has been a central descriptive concept for understanding livestock population dynamics in arid rangelands, particularly in face of drought. KR are suspected to preserve livestock during scarce times while animal numbers decline without them. However, a mechanistic concept of KR is still missing. In particular, a link between the KR concept and mechanisms of sustainable strategies of natural resource management has not yet been specified. In order to create such a link, we present a holistic modelling approach to evaluate and to adjust range management. Our purpose is to identify and to assess KR within the variable environment under different socio-economic contexts. First, we build a grazing model with a heterogeneous distribution of vegetation and stochastic rainfall. Second, we evaluate the influence of movement decisions and the availability of local KR on resource use under different evaluation criteria. Hence, our modelling approach allows the evaluation of how socio-economic conditions influence the role of KR for ecological sustainability in rangelands.



## **Benefits of pattern oriented parameterisation for generic models with an example from semi-arid rangeland management**

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Natural resource management often intends to provide management strategies that are applicable to a broad range of situations while covering essential elements of biological realism. There are basically two different approaches to achieve those general management principles. On the one hand, the use of specific models poses the challenge to generalise the results for a broader area of application. On the other hand, generic models directly aim to a general understanding of a system. However, for generic models there is a lack of established parameterisation strategies to detect biological realistic parameter sets without analysing the whole range of parameters. Here, we develop a pattern oriented parameterisation approach using qualitative pattern to extract biologically realistic areas from the parameter space. To illustrate the benefits of our approach we analyse an example from semi-arid grazing systems. We build a generic vegetation model driven by highly variable precipitation and livestock grazing to detect well adapted grazing strategies for an effective risk management. In this presentation, we first specify the qualitative patterns used in the parameterisation. Secondly, we explore the range of plausible parameter sets resulting from the parameterisation, and educe different functional groups. Next, we discuss the resulting dynamics of each functional group and finally draw conclusions for sustainable livestock management in semi-arid rangelands.



POSTER PRESENTATIONS:**Impact of *Retama raetam* and biological soil crust cover on the distribution of nutrients in a semiarid dune ecosystem, NW Negev**Sylvie Drahorad<sup>1</sup>, Peter Felix-Henningsen<sup>1</sup><sup>1</sup> Institut of Soil Science and Conservation, Justus Liebig University

Semiarid dune ecosystems are stabilized by patches of different shrub species and biological soil crusts (BSC). BSC are intimate associations of cyanobacteria, lichen and mosses. Especially on nutrient-poor sands plants and BSC act as “ecosystem engineers” accumulating nutrients and altering soil characteristics. These accumulations cause higher resilience against disturbance. The dunes of the NW Negev in Israel are covered by BSC and *Retama raetam*. At three study sites (90/ 130/ 170 mm a<sup>-1</sup> precipitation) the organic carbon content ( $C_{org}$ ), total nitrogen (Nt),  $K^+$ ,  $Ca^{2+}$  and  $Mg^{2+}$  were determined. To test the spatial variability of nutrients BSC (0-2 cm), topsoils (2-10cm) and subsoils (10-25cm) were sampled beneath *Retama raetam* and in the interspace. The sampling followed a relief transect which included the south exposed and north exposed slope and the interdune area. Both cover types increase the total amount of all measured variables. This increase correlates with the amount of available moisture. The horizontal and vertical distribution of nutrients is related to the cover type, the relief position and the total amount of rainfall at the single study sites. Spatial distribution of nutrients in semiarid landscapes is linked to biotic and abiotic factors like BSC cover, vegetation and relief. Predictions of land use impact on these highly vulnerable ecosystems need to be related to these aspects.



## **Response of dryland natural vegetation to simulated change of climate and land use**

*Katja Geißler*<sup>1</sup>, Martin Köchy, Florian Jeltsch

<sup>1</sup> Plant Ecology and Nature Conservation, University of Potsdam

Grasslands in arid regions are important for extensive livestock grazing or hay production. But vegetation cover is more than just fodder. High vegetation cover also leads to increased infiltration rate of rain water into the soil and thus, reduces the risk of soil erosion and groundwater loss.

In order to assess how both future climate change and grazing intensity will affect vegetation cover and erosion in Israel, Jordan and the Palestinian Authority we simulate vegetation changes by using computer models. The model we use, WADISCAPE, simulates a typical Mediterranean wadi landscape with 1.5 km x 1.5 km resolution under continuous grazing by sheep and goats. It integrates results of three process-based models for shrubs, annuals and trees respectively, all of them with finer spatial and temporal resolution than the landscape model. We evaluate different climate change scenarios, specific climatic extremes and several livestock grazing intensities ranging from 0 to 10 animals/ha. By varying the intensity of grazing, we can determine the theoretical average grazing capacity of a wadi landscape. We can also use the modeling to estimate erosion and runoff generation. Simulation results are summarised in the form of digital maps of the region showing biomass production, capacity for livestock, runoff generation and erosion risk.



## Feedbacks between vegetation and hydrology with a special view on extreme events in Israel

Stefanie Prange<sup>1</sup>, Katja Geißler<sup>1</sup>

<sup>1</sup> Plant Ecology and Nature Conservation, Potsdam University

Climate change will have a complex impact on rainfall characteristics. On the one hand, a decrease in mean annual precipitation is expected, which leads to a drier climate. On the other hand, an increase in the occurrence of extreme rainfall events is predicted. Both trends are observed over the past few decades in the Middle East, especially in the Jordan River region of Israel. In Mediterranean regions natural vegetation is very sensitive to water shortages. Vegetation growth is dynamically linked to rain amounts and hydrological processes in the soil. Therefore, it is important to investigate the effects of altered rainfall on these dynamics. The rain generator *ReGen* (Köchy, 2006) was used to produce stochastic time series for different extreme rainfall event scenarios in Israel. We used these time series to drive the model *EcoHyD* (Tietjen et al., 2009). This model was designed to simulate vegetation dynamics related directly to soil water. Aim of our approach was to conduct landscape vulnerability analysis along the aridity gradient in Israel. Feedbacks between vegetation and soil water in Israel are also discussed.

**Köchy M. (2006):** Stochastic time series of daily precipitation for the interior of Israel, *Israel Journal of Earth Science* 55: 103–109.

**Tietjen B., Jeltsch F., Zehe E., Classen N., Groengroeft A., Schiffers K., Oldeland J. (2009):** Effects of climate change on the coupled dynamics of water and vegetation in drylands, *Ecohydrology*.



## **Plant biodiversity and phylogenetic diversity patterns of the southern Mongolian Gobi**

*Jan Treiber*<sup>1</sup>, Henrik von Wehrden<sup>2</sup>, Jan Hanspach<sup>3</sup>, Jürgen Kluge<sup>4</sup>, Karsten Wesche<sup>1</sup>

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<sup>4</sup> Faculty of Geography, University of Marburg

The southern Mongolian Gobi is characterised by mountains in a wide lowland matrix. Environmental gradients are pronounced; thus biodiversity should be mainly controlled by abiotic constraints, especially moisture availability. We tested if plot-level species diversity and phylogenetic diversity can be equally well explained with environmental variables based on a set of 1416 relevés. We used climatic variables (WorldClim), an elevation model (SRTM) and a remote sensing productivity layer as predictors. We calculated the phylogenetic diversity based on a phylogenetic tree. Since the slopes of regressions for both dependent variables differ among vegetation formations, these were used as an additional nominal predictor. Data were analysed with ANCOVAs. Plant species diversity was mainly determined by the precipitation gradient, yet despite redundancies altitude and productivity could also be kept in the final model. This yielded an  $r^2=0.61$ , which was almost twice as high as the explained variance for the phylogenetic diversity. Phylogenetic diversity was hardly related to continuous predictors, and instead largely explained by the vegetation formations. Thus increasing dryness of sites indeed resulted in lower species diversity. This was less pronounced regarding the phylogenetic diversity; since even dry sites harboured a relatively broad range of taxa. However turnover rates between formations are often high, indicating non-continuous predictors shaping diversity relations.



## Effects of the savanna woody species *Acacia mellifera* and *Tarchonanthus camphoratus* on soil chemistry

Juliane Trinogga<sup>1</sup>, Kerstin Wiegand<sup>2</sup>, David Ward<sup>3</sup>, Sabine Reinsch<sup>4</sup>, Jana Schleicher<sup>1</sup>, Ingo Schöning<sup>1</sup>

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Savannas are characterized by the co-dominance of grass and woody vegetation. The savanna biome covers approximately 20% of the world's land surface and secures the livelihood of many people by providing the basic food resource for wildlife and domestic livestock in regions too arid for crop farming. Shrub encroachment is an increase in density of shrubs often unpalatable and reduces the grass layer. This is of interest for economic reasons as well as for a basic understanding of savanna dynamics. The effects of these changes in vegetation structure on savanna soils are not fully understood. We investigated the soil chemistry in a semi-arid savanna in South Africa under and away from canopies of *Acacia mellifera* and *Tarchonanthus camphoratus* shrubs. Confirming the hypothesis of shrub-induced alterations of soil properties, we found an increase in pH, organic carbon and nitrogen as well as cation exchange capacity under adult shrubs. The hypothesis that *Acacia* as a legume enriches the soil with nitrogen which then contains higher N-levels than the soil in the matrix was partly rejected: the non-N-fixing *Tarchonanthus camphoratus* also seems to accumulate nitrogen to the same amount. Overall, these results support the hypothesis of nutrient redistribution by savanna shrubs, i.e. an increase in nutrient status underneath the plants and a decrease in the grass/bare ground matrix. Changes in soil chemistry are altered slowly and thus will have an impact on ecosystem structure long after the visible causes have disappeared.



**Response of chlorophyll fluorescence, photosynthesis and transpiration in *Robinia pseudoacacia* L. to drought stress**

Maik Veste<sup>1</sup>, Wolf-Ulrich Kriebitzsch<sup>2</sup>

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<sup>2</sup> World Forestry, Johann Heinrich von Thünen-Institute Federal Research Institute for Rural Areas, Forestry and Fisheries, Hamburg

Black locust is well suitable for the production of biomass for bioenergy. The tree can be cultivated in short-rotation plantations on marginal arable land. As a pioneer species the tree grows under a wide range of conditions and is used for reclamation of open-cast lignite mining areas in Brandenburg (mean annual rainfall 560 mm). The native distribution area of black locust is classified by a humid to sub-humid climate with annual precipitation range from 1020 to 1830 mm. In Central Europe, *Robinia pseudoacacia* L. is known to be relatively drought tolerant compared to other temperate, deciduous tree species. However, the establishment of saplings in plantations is sensitive to drought in spring and early summer. In order to evaluate the growth and ecophysiological performance of Robinia to drought stress, a pot experiment was established at the Johann Heinrich von Thünen-Institut, Hamburg. We studied the photosynthetic performance with a PAM 2100 chlorophyll fluorescence system. Net CO<sub>2</sub> exchange and transpiration were determined with a minicuvette system CMS 400. Mean electron transport rates ranged from 93  $\mu\text{mol m}^{-2} \text{s}^{-1}$  in drought stressed plants to 118  $\mu\text{mol m}^{-2} \text{s}^{-1}$  in the well-watered plants, respectively. Net photosynthesis ( $A = 3.65 \mu\text{mol m}^{-2} \text{s}^{-1}$ ) and transpiration ( $Tr = 0.5 \text{ mmol m}^{-2} \text{s}^{-1}$ ) were reduced by drought due to stomatal closure compared to the well-watered control ( $A = 6.1 - 9.7 \mu\text{mol m}^{-2} \text{s}^{-1}$ ,  $Tr = 0.93 - 1.25 \text{ mmol m}^{-2} \text{s}^{-1}$ ). To minimize transpiration on plant level leaf area was reduce by drastic leaf fall.



## SESSION 02 - BIODIVERSITY OF AQUATIC ECOSYSTEMS AND WETLANDS

CONVENOR: JÜRGEN MARXSEN, ELISABETH POHLON, STEFAN HOTES

### ORAL PRESENTATIONS:

#### **Spatial and temporal variations of deep-sea bacterial diversity at the arctic long-term observatory HAUSGARTEN**

*Marianne Jacob*<sup>1</sup>, *Alban Ramette*<sup>2</sup>, *Thomas Soltwedel*<sup>1</sup>, *Michael Klages*<sup>1</sup>, *Antje Boetius*<sup>1</sup>

<sup>1</sup> *HGF-MPG Group for Deep Sea Ecology and Technology, Alfred-Wegener-Institut  
Bremerhaven*

<sup>2</sup> *Max-Planck-Institute Bremen*

Benthic bacteria play a major role in the remineralisation of organic matter sedimenting from surface waters to deep-sea sediments, and may be the first to respond to environmental variations due to their relatively short generation times and rapid adaptation means. Long-term studies at the Arctic deep-sea observatory HAUSGARTEN (Fram strait) show a decreasing flux of phytodetrital matter to the seafloor as well as a decrease in the inventory of sedimentary organic matter and total microbial biomass from 2001 to 2005. We have investigated the relationship between changing environmental factors and bacterial diversity to identify the main parameters shaping bacterial diversity and community structure. Bacterial diversity of the upper 5 cm sediment layer was determined using Automated Ribosomal Intergenic Spacer Analysis (ARISA) and correlated with contextual biotic and abiotic factors applying multivariate statistics. The results show that patterns of bacterial diversity group according to ocean floor depth which relates to energy availability in the form of sedimenting phytodetritus. A strong effect of time can be found at stations within the same depth range. We recorded a strong shift of the benthic bacterial community associated with warming of the ocean which needs to be further investigated. With these observations we have first insights into the influence of recent environmental changes in the Arctic on bacterial benthic communities in the deep-sea.



**Effect of seawater acidification on microbial community diversity – Lessons from natural CO<sub>2</sub> leaks**

*Judith Neumann*<sup>1</sup>, Alban Ramette<sup>2</sup>, Matthias Haeckel<sup>3</sup>, Dirk deBeer<sup>4</sup>, Fumio Inagaki<sup>5</sup>, Antje Boetius<sup>6</sup>

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CO<sub>2</sub> rich hydrothermal vents can be regarded as natural laboratories to investigate risks associated with mitigation strategies to climate change, as in the industrial process of CO<sub>2</sub> capturing and storage (CCS) in the ocean. Some leakage sources are vent chimneys others are small cracks in the sedimentary seafloor, or diffusive transport of CO<sub>2</sub> through the sediment. The highly concentrated liquid CO<sub>2</sub> seeping through the seafloor induces a considerable decrease in pH from a background of pH 7.9 to pH 4 at the vents. Along this pH gradient from low to high CO<sub>2</sub> concentrations, changes in macrofauna distribution occurs (decreasing richness). Microbial communities on the other hand represent one the key levels for ecosystem functioning, but their short- and long-term structural and functional responses to changes in ocean pH are not well understood. So far only two previous studies have been dealing with the topic of increased CO<sub>2</sub> levels on benthic ecosystems (Inagaki et al. 2006; Hall-Spencer 2008). We examined how natural gradients in pH and CO<sub>2</sub> flux across the Yonaguni Knoll basin of the Okinawa trough impact benthic bacterial communities. Changes in function were assessed as differences in the sustained biomass, and in the respiration of reduced compounds. Changes in bacterial community structure were analysed by community fingerprinting using ARISA (Automated Ribosomal Intergenic Spacer Analysis). Our data show a strong shift in benthic community structure and function along in situ pH gradients mimicking CO<sub>2</sub> leakage.



## **Role of seed bank and vegetative growth in re-colonization of gaps in Baltic salt grassland vegetation**

*Kristin Ludewig*<sup>1</sup>, Antonia Wanner<sup>1</sup>, Kai Jensen<sup>1</sup>

<sup>1</sup> Biocenter Klein Flottbek, University of Hamburg

Vegetation gaps are considered to be important for germination and establishment of species, which are weak competitors but have long lived seeds in the soil. Vegetative growth is a frequent colonization strategy especially in regularly disturbed grasslands. How important are these two strategies in re-colonizing vegetation gaps in Baltic salt grassland? We conducted a two factorial field experiment at the Baltic Coast of Germany to answer this question. We created 48 gaps of 0.4 m<sup>2</sup> size in autumn 2006, excluded the seed bank by sterilization and vegetative growth by a dense nylon mesh in a full factorial design. Additionally, we marked control plots without manipulation in the established vegetation. Seedlings and ramets were counted in the gaps in summer 2007 and 2008. Both, seed bank and vegetative growth contributed to the re-colonization of the experimental vegetation gaps. Interestingly, more seedlings emerged in the undisturbed control plots than in the gaps with intact seed bank. A flooding for six weeks in summer 2007 resulted in high seedling mortality. Overall, vegetative ramets were more successful in establishing in the gaps than seedlings. We conclude that seedling establishment out of the seed bank is limited in vegetation gaps in this Baltic salt grassland. Vegetation gaps do not even seem to be necessary for germination of halophyte species. We assume that the erect structure of the vegetation dominated by the evergreen plant *Juncus gerardii* facilitates germination in the undisturbed vegetation.



## Large Lakes of Holarctic as donors and recipients of aquatic invasions

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It is now recognised that successful biological invasions result from a series of interconnected stages: introduction effort across geographic barriers, suitability of physiochemical conditions in the new environment, and establishment in the local ecosystem. We focus on the historical background to invasions of mollusks and fishes in large lakes of Holarctic as an integral part of evolution of the region's natural and man-modified faunas, and investigate several assumptions explaining why these basins are great donor-and-recipient regions. The invasiveness of Ponto-Caspian species in Volga dam-lakes, Baltic Sea, Laurentian Great Lakes, and other lakes outside their native ranges, both freshwater and brackish, stem from their evolved salinity tolerance owing to the geological, climatological and biogeographical history of their native region as well as from their taxonomic position and phylogenetic. Comparisons of the contemporary and historical landscapes reveal that impoundments of large East European rivers enhance the invasion success of some species, highlighting the role of human-altered ecosystems as "stepping-stone" habitats for the continued spread of invaders of the lacustrine or marine (talassoid) origin along intercontinental invasion corridors. Data will be presented to demonstrate that some recent invasions are very similar to historical ones (so-called palaeoinvasions) which took place in the Quaternary following transgression and regressions of the sea.



## **Why does restoration of aquatic macrophytes fail? A case study on *Potamogeton malaianus* at Lake Kasumigaura, Japan**

Stefan Hotes<sup>1</sup>, Jun Nishihiro<sup>2</sup>, Izumi Washitani<sup>2</sup>

<sup>1</sup> Research Centre for BioSystems, Land Use and Nutrition, Justus-Liebig-University Giessen

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Aquatic macrophyte vegetation is notoriously difficult to restore in shallow eutrophic lakes, especially if all above-ground vegetation has been lost and restoration attempts with material that is available in situ have to rely on the soil seed bank. In order to improve restoration success it is important to understand which processes limit the establishment of aquatic plants. In this study we focused on the question under what conditions seeds of *Potamogeton malaianus*, a pond weed that is widely distributed in East Asia, can germinate and establish seedlings. Germination experiments in the lab, in mesocosms and in the field were combined for this purpose. Germination success was high in all three experimental settings, proving that germination is not the limiting process. Striking differences were found, however, in the number of live seedlings between mesocosms and the field experiment. Whereas seedlings were able to establish in the mesocosms, none were found under field conditions. The role of physical and chemical factors and the possible influence of herbivores on seedling survival is discussed.



## Use of cross-taxon congruence analysis to identify potential surrogate taxa for freshwater biodiversity

*Margherita Gioria*<sup>1</sup>

<sup>1</sup> University College Dublin

Cross-taxon congruence analysis can be used to identify surrogate taxa to be used in rapid biodiversity surveys. To date, the degree of correspondence between taxa has been mainly evaluated using Mantel tests. Here, I describe a combination of multivariate approaches that can be used to quantify the correlation between community data matrices, using water beetle (77 species) and wetland plant (66 species) data from 54 farmland ponds in Ireland. Specifically, I used: 1) parametric and non-parametric Mantel tests, 2) co-correspondence analysis (Co-CA); predictive canonical correspondence analysis (CCA-PLS); and 4) Procrustes analysis. The correspondence between the results of non-multidimensional scaling (NMDS) and those of principal components analysis (PCA) summarizing patterns for 12 environmental variables was also assessed. Mantel tests and symmetric Co-CA showed a moderate correspondence between plant and beetle data (ca. 30%), while a higher correlation was found using Procrustes analyses (57-72%). Plant species composition was a good predictor of water beetle species composition, and its predictive capacity was comparable to that of environmental variables. CCAs showed that plant and beetle assemblages respond similarly to the same set of environmental conditions, although Procrustes analysis highlighted a stronger response of water beetles to such variables. The differences between the approaches used to assess the correspondence between data matrices are discussed.



**Quantifying the simultaneous effects of multiple pressures on the biodiversity of agricultural ponds to obtain an integrated indicator**

*Taku Kadoya*<sup>1</sup>, Munemitsu Akasaka<sup>1</sup>, Takashi Aoki<sup>2</sup>, Noriko Takamura<sup>1</sup>

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<sup>2</sup> City of Kobe, Japan

One of the promising approaches to monitoring biodiversity is assessing the status of pressures driving the biodiversity state. To achieve this, we need to identify the principal pressures that cause simultaneous biodiversity loss across taxonomic groups and clarify how multiple pressures act synergistically or at least simultaneously to decrease biodiversity in the focal ecosystem. Here, we used an agricultural pond ecosystem as a case study and we developed a framework for an integrated biodiversity indicator that took into consideration the estimated relative importance of multiple pressures. Using this framework, we demonstrated that eutrophication had greater effects on the state of biodiversity of the agricultural ponds than did habitat destruction or the presence of invasive alien species. We also showed that the integrated indicator could well explain the behaviors of several individual biodiversity indicators, including total richness, endangered species richness, and functional diversity of focal taxa.



**Assessing responsible species traits for local extinction of aquatic macrophytes: Impact of urbanization and bank protection**

*Munemitsu Akasaka*<sup>1</sup>, Shinsuke Higuchi<sup>2</sup>, Mitsuhashi Hiromune<sup>3</sup>, Takamura Noriko<sup>1</sup>, Kadono Yasuro<sup>2</sup>

<sup>1</sup> National Institute for Environmental Studies

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<sup>3</sup> The Museum of Nature and Human Activities, Hyogo

Extensive land-use alteration, including urbanization, is one of the major drivers causing biodiversity loss. Understanding how land-use alteration would be related to the biodiversity loss in a habitat is an important issue in conservation ecology as well as landscape ecology. To foresee which species is likely to be extinct, recent studies adopt a trait-based approach. Previous studies employing the trait-based approach mostly examine relationships between extinction risk of species and their own traits, and disregard drivers which lead species to extinction. However, the traits that lead species to extinction can differ with extinction drivers. Therefore, evaluation of the traits that make species prone to extinction needs to incorporate extinction drivers. In this study, we conducted an extensive aquatic macrophyte survey at 110 irrigation ponds in Hyogo, Central Japan in two time periods (1992-7 and 2006-9), and analyzed which species trait (growth form, life cycle, and apparent vegetative reproduction) would be responsible for local extinction of macrophytes in the ponds which are facing the risk of urbanization and bank protection. Based on the results, we discuss advantages of the approach that relates species traits to the responses of focal organisms to alternation of landscape structures.



### **Rhizosphere Dynamics of 3 riparian plant species from TGR water fluctuation zone – A floodable rhizobox as an approach to observe oxygen, pH and soil solution properties in high resolution**

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The establishment of Three Gorges Reservoir produced a 30m water fluctuation zone, 45-75m above the original water level and prone to erosion. To assess survival strategies and ability to prevent soil runoff and erosion, the rhizosphere of the flooding resistant species *S. variegata*, *A. philoxeroides* and *A. anomala* has been monitored for reactions to submergence by means of a floodable rhizobox. O<sub>2</sub>- and pH- sensitive foils allowed non-invasive monitoring of root reaction on the backside of the rhizobox, while soil solution samples were taken from the front side at the corresponding area. Samples were analyzed by capillary electrophoresis for organic acids (OA). Flooding cycles (waterlogging, flooding, recovery in a 2- and 14 day rhythm) have been simulated in different substrates. Results show diurnal rhythms of rhizospheric acidification, combined with oxygen entry into the root surrounding during waterlogged state. Flooding caused stronger acidification in the rhizosphere, sometimes accompanied by increased occurrence of OA. Stable diurnal rhythms were found during waterlogging, but no strongly increased activity during the flooding event. *A. anomala* with its strong root system and ability to survive flooding is considered most suitable for re-vegetating the riverbanks to help prevent further erosion. The floodable rhizobox with its potential to measure non- or very low-invasively has proved to be a very useful tool for gaining high resolution insights into the rhizosphere.



### **Longitudinal distribution of riparian vegetation in a Chinese temporary stream**

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A phytosociological study was conducted in riparian grasslands of the Yongding-Hai river system, a 270 km long, strongly anthropogenically impacted stream flowing across the capital Beijing and Tianjin, the third largest city in China. Several sections of this stream systems remained dried out for several years due to water abstraction in the catchment. The study aims at identifying longitudinal diversity and composition patterns of vascular plants and quantifying the effects of the hydrology soil parameters and land use on vegetation distribution. 162 plots located on 15 transects along the 270 km river stretch were systematically investigated along ecological gradients from the river bank to the floodplain terrace in August and September, 2009. A total of 40.000 individuals distributed among 140 species, 104 genera and 48 families were found. Species diversity varied between transects but tended to decrease in the downstream transects. Diversity of plots located on dry river sections was not significantly lower, showing that beside flow disruption, other environmental parameters such as soil moisture or nutrients or land use may play an important part in explaining plant distribution.



**A trait-based method to assess pesticide effects on freshwater communities and to evaluate the efficiency of buffer strips for mitigation**

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Pesticides, in particular insecticides, have adverse short- and long-term effects on freshwater communities. They enter surface waterbodies via point sources (e.g. waste water treatment plants and stormwater runoff) and non-point sources (mainly surface runoff). However, determining the full extent of biotic effects is difficult as community composition is driven by several additional anthropogenic and natural factors. Here we used the trait-based index SPEARpesticides (SPEcies At Risk) that establishes an exposure-response relationship between community structure and pesticide stress. Using a data set of more than 400 sampling points in Hesse, Germany, we found strong indication for treatment plants being major contributors to pesticide input. Furthermore, we predicted levels of pesticide runoff and effect using a GIS-model. By comparing predicted levels of pesticide input with measured community response we found that buffer strips are an efficient morphological element of running waters against pesticide runoff into streams. We also quantified the relationship between buffer strip width and mitigation effects. Thus, the optimization of waste water treatment plants, the management of storm water overflows and the enhancement of buffer strips along waterbodies can mitigate or even prevent adverse effects on freshwater communities. This would also support the achievement of good chemical and ecological status of waterbodies as required by the EU Water Framework Directive.



**Changes of plant diversity in riparian grassland after extreme hydrologic events – A case study at the Elbe, Germany**

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Alluvial Grasslands dominate the floodplains along the middle reach of the River Elbe. In a monitoring project, vegetation data of a riparian grassland site were collected in three different periods over 12 years. The effects of two extreme hydrologic events, the summer flood of 2002 and the extreme low water of 2003, on plant diversity were analysed. The study site is characterised by a high variation in relief. Therefore, the plots were classified into three groups according to their hydrology: flooded depressions with amphibian vegetation, wet and moist grassland. The study showed that between 1999 and 2003, species richness and Shannon's diversity index declined in all classes while Simpson's dominance increased. In the following years until 2009, species richness increased and reached even higher levels than before 2002 in wet and moist grassland. In these classes Shannon's diversity and Simpson's dominance indices reached values similar to those of 1998 and 1999. For the vegetation of the flooded depressions, these indices did not recover. This case study shows that changes in hydrology such as extremely high or low water levels can affect floodplain vegetation in a way that biodiversity declines and needs some years to recover. However, it remains uncertain if the flood event of 2002 or the drought of 2003 or both led to the observed changes in vegetation. A yearly monitoring (KLIWAS project) of these sites at least until 2013 may provide further understanding of the effect of extreme hydrologic events.



## **Reaction of carabid beetles to the extreme summertime flood event of the river Elbe in 2002**

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Many studies have shown that the biological trait composition of a species community is driven by environmental conditions. However, extreme events leading to extreme environmental changes (e.g. extreme floods) can alter species communities very quickly and in unexpected directions. In August 2002, the river Elbe was affected by the highest flood ever recorded: one of central Europe's biggest natural disasters in living memory. In this study, we aim at resolving the environment-biological trait interaction under the influence of this extreme flood event using carabid beetles as a model organism group. We also aim to study resilience capacity over five post-flood years. This study is unique in two ways. First, it uses a pre- and post-extreme event long-term dataset, which is extremely rare to find, because extreme events are rare by definition (once in 168 years in our case) and most often true pre-event data from the same plots (and an appropriate number of replicates) are not available. Second, biodiversity is measured on two levels, community composition and functional diversity, which enables us to address a broad set of hypotheses related to diversity patterns at all of these levels. Finally, the analysis of the link between flood adaptation and resilience will provide insights into how or whether impacts of extreme events differ from smaller scale disturbances.



## Simulating the population dynamics of *Corbicula fluminea* under varying environmental conditions – An energy budget based approach

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*Corbicula fluminea* is an invasive species in river Rhine and therefore in the focus of both experimental and monitoring approaches. On the individual level Weitere et al. (2009) determined growth and reproduction depending on temperature and food level. They revealed dynamics which can only be described by a dynamic energy budget (DEB) model (Kooijman, 2009). On population level Meister (1997) surveyed heterogeneous length frequency distributions, and Westermann and Wendling (2003) reported mass mortality phenomena under comparably high temperatures. Moreover, decreasing plankton concentrations observed in recent years are commonly attributed to this major filterer and can be seen as a self-induced environmental change (Friedrich and Pohlmann, 2009). Physiologically structured population models (PSPM) are an accepted tool to describe such phenomena. However, the experimental results of Weitere et al. (2009) suggest that it does not suffice to choose one instantaneous physiological measure e.g. individual length. In order to adequately simulate maintenance and reproduction at the population level “memorizing units”, that is individual weight and reproductive power, must be taken into account concurrently. The aim of this project was to set up an appropriate population model for *C. fluminea*, apt to reproduce existing survey results and applicable for systems analysis and prediction. To this end, we parameterized a DEB model based on the experiments of Weitere et al. (2009) and embedded it successfully in a “multiple PSPM”.

**Friedrich, G. and M. Pohlmann (2009).** Long-term plankton studies at the lower Rhine/Germany. *Limnologia* 39 (1), 14–39.

**Kooijman, S. (2009).** Dynamic Energy Budget theory for metabolic organisation. Cambridge University Press.

**Meister, A. (1997).** Lebenszyklus, Autökologie und Populationsökologie der Körbchenmuscheln *Corbicula fluminea* und *Corbicula fluminalis* (Bivalvia, Corbiculidae) im Inselrhein. Umweltplanung, Arbeits- und Umweltschutz (Schriftenreihe Hessisches Landesamt für Umwelt) Heft 238.

**Weitere, M., A. Vohmann, N. Schulz, C. Linn, D. Dietrich and H. Arndt (2009).** Linking environmental warming to the fitness of the invasive clam *Corbicula fluminea*. *Global Change Biology* 15 (12), 2838–2851.

**Westermann, F. and K. Wendling (2003).** Was ist die (wahrscheinlichste) Ursache des „Muschelsterbens“ im Rhein im Hochsommer 2003? Report: Landesamt für Wasserwirtschaft Rheinland-Pfalz.



POSTER PRESENTATIONS:

**Habitat mapping in the German Wadden Sea**

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The Wadden Sea is a highly dynamic system which is formed by strong factors like the tidal current, wind and many more. Due to these dynamic processes there are numerous changes of biotic and abiotic parameters which clearly affect the biocenosis living in the Wadden Sea. The habitat model follows the method of the EUNIS habitat map for the MESH study area which was developed by Natalie Coltman et al. for the Joint Nature Conservation Committee in 2008. The Habitat Map method suits the given abiotic and biotic conditions of the study area but lacks further possibilities for tidal flats and estuaries. A habitat model for the Wadden Sea needs a more small-scaled system with regard to its dynamic nature, which is the prospectively intended goal of the presented work. This is supposed to work out based on correlations between abiotic and biotic parameters and the biodiversity of the Wadden Sea. Therefore the correlation between the substrate composition and macrobenthos occurrences in the Wadden Sea are under study at the moment.



## **Ship-induced waves alter the macrozoobenthos community composition of the Havel River by favouring neozoa**

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Ship-induced waves impact littoral invertebrates, e.g. by displacing individuals. However, the long-term effects of ship-induced waves on the littoral macrozoobenthos community composition have rarely been quantified. Macrozoobenthos was sampled at a stretch of the river Havel between Potsdam and Brandenburg, comparing sites highly exposed to ship-induced waves with sites which are intermediately exposed and reference sites without wave disturbance. A gradient of wave exposure was verified by monitoring wave heights from April to October 2008. At the highly exposed sites species richness and individual abundances were reduced in comparison to not exposed reference sites. However, invasive species such as the shrimp *Dikerogammarus villosus* or the mussel *Dreissena polymorpha* occurred in higher densities at highly exposed sites. Hence, ship-induced waves impact the community composition of littoral macrozoobenthos by favouring neozoa.



## **Habitat change of wet and species-rich mesic meadows in northern Germany since the 1950s**

*Benjamin Krause*<sup>1</sup>, Heike Culmsee<sup>2</sup>, Karsten Wesche<sup>3</sup>, Erwin Bergmeier<sup>2</sup>, Christoph Leuschner<sup>1</sup>

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<sup>3</sup> Senckenberg Museum für Naturkunde Görlitz

Central European floodplain meadows are severely affected by land use change and intensification. We investigated quantitative and qualitative vegetation changes in 7 north German floodplain meadows (6 unprotected, 1 protected study sites) based on recent (2008) and historical (1950s-1960s) vegetation maps, considering their spatial extent, fragmentation, and replacement by other land use types. Despite different initial political situations affecting land use practices, all unprotected sites showed parallel trends of severe floodplain meadow habitat loss (>80%) and fragmentation, inhibiting natural dynamics and fluctuations within the floodplain meadow complex. Recent changes were exclusively management-driven and remaining wet meadow communities were highly isolated. Site and management history seemed to be important for the present-day extent and quality of floodplain meadows, which needs to be considered by restoration and conservation initiatives. The majority of former wet and species-rich mesic meadows were lost and substituted either for more intensely managed area or abandoned, depending on moisture regimes. This resulted in high fragmentation of remaining patches. The history of the sites greatly influenced the present-day situation of the grasslands. An exception was one investigated protected area, where this trend was visible, but proceeded more slowly.



**Men induced long term vegetation changes in the Ciénaga Grande de Santa Marta (Colombia)**

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<sup>3</sup> INVEMAR, Santa Marta/Colombia

The lagoon system of the Ciénaga Grande de Santa Marta on the Caribbean coast of Colombia is characterized by numerous lagoons of different sizes, sandy dunes and alluvial plains. The ecological conditions of the lagoon system permit the presence of different plant communities from which mangroves are the most important. In the last fifty years the lagoon system was exposed to contrary interventions in its hydrological system. Reduction of freshwater supply from 1960 up to 1995 resulted in a salinity increase and vegetation damages. With the purpose to restore the ecosystem, from 1995 up to 1998 several channels were opened between the Magdalena River and the lagoon system to renew the freshwater supply. These hydrological changes affected the plant communities in a different manner but were most obvious in mangroves. When salinity increased, mangrove forests died to a large extent (286 km<sup>2</sup>). After the renewal of freshwater supply, the regeneration of the vegetation began showing differences between the eastern and the western part of the lagoon system. In the eastern more saline part mangroves recovered slowly to the original species composition and zonation. In the western part, mangrove regeneration was delayed by the establishment of *Typha domingensis* in former mangrove areas. Only when surface water salinity rose and the cattail died, mangroves got a chance to extend. But the new forests differ from the original ones due to the poor regeneration of *Rhizophora mangle*.



## Characterization of temporary ponds situated on alluvial fans in the Csík Basin (Eastern Carpathians, Romania)

László Demeter<sup>1</sup>, Anna-Mária Csergő<sup>2</sup>, Gabriella Péter<sup>1</sup>, Edina Miklós<sup>1</sup>, Éva György<sup>1</sup>

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<sup>2</sup> Sapientia University, Marosvásárhely, Romania

The alluvial fans which fill the western and eastern parts of the Csík Basin (Munții Ciucului), Eastern Carpathians, are a characteristic feature of this landscape. On the surface of alluvial fans we mapped more than 250 ponds. The aim of our research in 2009 was the survey of their flora and selected elements of the fauna, and elaboration of nature conservation proposals. Typical plants found in the ponds were: different species of sedge (*Carex vesicaria*, *C. acuta* ssp. *erecta*, *C. rostrata*, *C. lasiocarpa*, *C. elata*, *C. caespitosa*), broadleaf cattail (*Typha latifolia*), common bladderwort (*Utricularia vulgaris*), purple marshlocks (*Comarum palustre*). We identified 11 rare or glacial relic plant species, like *Lysimachia thyrsoflora*, *Eriophorum vaginatum*, *Cicuta virosa*, *Menyanthes trifoliata*, *Carex diandra*, *Ribes nigrum*, *Spiraea salicifolia*. In the zooplankton we found several rare crustaceans (*Chirocephalus shadini*, *Arctodiaptomus belgrati*) which presently are not protected because of the lack of previous knowledge about their distribution. In the Csík Basin the studied pond type is the most important reproduction habitat for the moor frog (*Rana arvalis*), smooth newt (*Triturus vulgaris*) and great crested newt (*T. cristatus*). Although generally speaking the studied ponds represent the freshwater habitat type least affected by wetland regulation works in this area, they are a very vulnerable and precious habitat type, therefore need protection.



## **Estimating the effect of global change on riverine carbon dynamics – An Amazon case study**

*Fanny Langerwisch*<sup>1</sup>, Anja Rammig<sup>1</sup>, Kirsten Thonicke<sup>1</sup>, Wolfgang Cramer<sup>1</sup>

<sup>1</sup> Earth System Analysis, Potsdam Institute for Climate Impact Research

The Amazon River discharges nearly 20% of the earth's fresh water. The river catchment covers approximately six million square kilometers. One major driving factor in Amazonia is annual flooding during which terrestrial and riverine components are closely connected and an intense exchange of organic material occurs. The large carbon fluxes in this system are expected to change due to land use and climate change. To estimate the amount of these carbon fluxes under various land use and climate change scenarios we use the dynamic global vegetation and water balance model LPJmL. We adapted LPJmL to realistically reproduce observed discharge and calculate inundation area. We additionally developed a new riverine carbon module that calculates conversion of terrestrial organic matter during the river passage. Our results indicate that by the end of the 21<sup>st</sup> century, significant changes in inundation patterns are likely to occur. Inundated area will increase, high/low water peak months will shift by up to 3 months and inundation length will increase by 1 to 3 months. These changes will have consequences on regional organic carbon balance. Because Amazonia plays a vital role for global water and carbon cycles changes in these fluxes will therefore also have global impacts. The aim of our study is to understand the complex interplay occurring in a floodplain and the effect of land use and climate change on these interactions on the scale of the Amazon basin.



## **Vegetation of floodplain meadows along the climatic gradient at the Middle Elbe River**

*Lotte Korell*<sup>1</sup>, Kristin Ludewig<sup>1</sup>, Franziska Konjuchow<sup>2</sup>, Mathias Scholz<sup>2</sup>, Kai Jensen<sup>1</sup>

<sup>1</sup> Biocentre Klein Flottbek, Hamburg University

<sup>2</sup> Helmholtz Centre for Environmental Research GmbH - UFZ

In Central Europe floodplain meadows (“Stromtalwiesen”) are mainly distributed along large river corridors under sub-continental climatic conditions. Hydrology and land use are main factors influencing floodplain vegetation. Several studies focussed on effects of hydrology and land use on species distribution and diversity in floodplain meadows. However, effects of climatic conditions on floodplain meadows are poorly investigated yet. The aim of this study is to detect differences in vegetation composition and diversity in floodplain meadows along the climatic gradient at the Middle Elbe river. The study is carried out in cooperation with the KLIMZUG-NORD project and the Helmholtz Centre for Environmental Research (Leipzig). The study area is situated in the UNESCO Biosphere Reserve “Flusslandschaft Elbe” between Wörlitz (Sachsen-Anhalt) and Bleckede (Niedersachsen). In total 55 vegetation plots were sampled in two habitat types (26 plots in wet grassland and 29 plots in mesophilous grassland) at six study sites along the East-West climatic gradient. Mean annual precipitation varies between app. 500  $\text{mma}^{-1}$  in Wörlitz and 613  $\text{mma}^{-1}$  in Bleckede. Data will be analysed with multivariate statistics. Findings of this study may allow us to predict changes in species composition and diversity under changing climatic conditions.



## Following the footsteps of the zebra mussel – A new freshwater mussel alarms Europe

Katharina C. M. Heiler<sup>1</sup>, Sascha Brandt<sup>1</sup>, Christian Albrecht<sup>1</sup> and Thomas Wilke<sup>1</sup>

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Invasive species pose one of the most serious threats to biodiversity. One of the best studied invasive species, the zebra mussel *Dreissena polymorpha* (PALLAS, 1771) invaded most freshwater systems in Europe already 200 years ago. In 2006, its congener, the quagga mussel *Dreissena rostriformis bugensis* (ANDRUSOV, 1897), also became invasive in Western Europe. First reported in the Rhine River in the Netherlands, individuals have been found in Germany only one year later. In North America, where both taxa are also invasive, the quagga mussel might negatively affect the zebra mussel or even displaces it. This raises questions about the very recent invasion of the quagga mussel in Western Europe:

- 1) What is the current distribution of the quagga mussel in Western Europe?
- 2) Does the quagga mussel affect the zebra mussel in Western Europe?
- 3) If so, what are the mechanisms causing the dominance of the quagga mussel?

To clarify these questions, the abundance and shell size of quagga and zebra mussels was determined in several Western European waterways in autumn 2009. Our findings show that 1) the quagga mussel extended its distribution into all examined inland waters in which the zebra mussel is present, and exceeded by far the number of zebra mussels in many localities, 2) the average shell size of adult zebra mussels decreases with increasing percentage of quagga mussels, and 3) a reduced growth rate, or a higher mortality of larger size classes of zebra mussels may explain their reduced shell size. Current studies are focusing on the determination of the growth rate and controlled aquarium experiments. It is suggested that a possible species shift from zebra to quagga mussels in Western Europe may affect not only the zebra mussel, but also native faunal elements.



## SESSION 03 - FOREST ECOSYSTEMS: BIODIVERSITY, FUNCTION AND STABILITY

CONVENOR: ANNETT WOLF, ANJA RAMMIG, FANNY LANGERWISCH

### ORAL PRESENTATIONS:

#### **TRY - a global database of plant functional traits**

*Jens Kattge*<sup>1</sup>, Gerhard Bönisch<sup>1</sup>, Sandra Diaz<sup>2</sup>, Sandra Lavorel<sup>3</sup>, Paul Leadley<sup>4</sup>, Colin Prentice<sup>5</sup>, TRY network

<sup>1</sup> Max-Planck\_Institute for Biogeochemistry

<sup>2</sup> Universidad Nacional de Córdoba, Argentina

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Functional traits of plants – i.e. their morphological, anatomical or physiological characteristics – determine how biodiversity translates into biotic interactions and ecosystem functions and services. Trait data thus represent the raw material for research in evolutionary biology, community and functional ecology research, and may support the prediction of forest responses in a changing environment. The TRY initiative ([try-db.org](http://try-db.org)) has developed a global, communal database of plant traits, which currently contains about 2.5 million trait entries for about 62000 plant species and which covers a range of more than 1000 different traits, with a focus on about 50 principle groups of traits. About half of the trait entries are geo-referenced. For some traits the database contains a substantial number of entries, which allow in-detail characterisation of plant characteristics. The TRY database is an ongoing project with the aim to become a long-term repository of plant functional trait data for the ecological community.



**Effect of forest cover continuity over time on plant species richness and composition in a Mediterranean area**

Valerio Amici<sup>1</sup>, Elisa Santi<sup>1</sup>, Giovanni Bacaro<sup>1</sup>, Goffredo Filibeck<sup>2</sup>, Francesco Geri<sup>1</sup>, Sara Landi<sup>1</sup>, Simona Maccherini<sup>1</sup>, Anna Scoppola<sup>2</sup>, Alessandro Chiarucci<sup>1</sup>

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<sup>2</sup> Faculty of Agriculture, University of Tuscia

European forests have been subjected to significant changes in land use for thousands of years. Many forested areas have been cleared, subjected to agriculture, and then afforested again several times. Thus we find, in the majority of Europe, a mosaic of forests differing in age. However, few ecological data comparing forests of different ages are available for the Mediterranean. In the present study floristic surveys were conducted on 604 plots located on the SCIs of the Siena Province (Tuscany, Italy) by a restricted random selection and 15 variables, divided in three groups (Forest age, Environmental-Landscape variables, and Spatial variables), were selected from those known in literature as the most important in explaining the variation in species richness and composition. Using variation partitioning methods, we determined the pure and shared effects of these three sets of explanatory variables on the plant species richness and composition in forests. Forest age was found to be a variable that contributes significantly to the floristic diversity in the considered forest areas; moreover the species richness and composition of the ancient forests were resulted significantly different from that of the recent forests within similar forest physiognomy. These results underline the need to consider that discriminating forests only through criteria based on physiognomy or environmental variables, may cause the loss of sources of variability, as forest age.



**Life from related scales of investigation in mountain forests**

*Michael Rudner*<sup>1</sup>, Frank Bode<sup>1</sup>, Melanie Manegold<sup>1</sup>

<sup>1</sup> Geobotany, University of Freiburg

All ecological results depend on the investigation scale. Successful research was already done concerning the selection of suitable scales for the study of vegetation stands. On the level of life forms this question remains open. We investigate which scale dependencies different life forms show relative to their distribution and how they interact concerning suitable scales for the investigation of the whole stands. Occurrence of selected species was observed using a discontinuous raster design. Six different life forms were studied in the understory of near-natural mountain forests. The study regions are situated in geomorphologically differing landscapes in the southern Black Forest. Scale dependence is analyzed using variance optimizing methods. Similarity indices were used to relate the occurrences of the different life forms to each other. Results for the whole stands are derived using these values. Differences between the suitable scales for the investigation of mosses and dwarf shrubs are smaller than expected. The dependence of the optimal scales on the number of integrated life forms is striking. The comparison of the variances between and within the life forms as well as the variance between the survey plots shows clear results which lead to recommendations according suitable investigations scales.



## **Pattern and process of large-scale tree mortality waves in the mountains of the SW United States**

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<sup>1</sup> Forest Ecology, ETH Zürich

<sup>2</sup> University of Arizona, Tucson, USA

Severe drought in 2000-2004 resulted in extensive tree mortality in the woodlands of the southwestern United States, but the processes underlying such “die-offs” remain uncertain. We examined the relationship between climate, diameter growth and mortality risk for piñon pine (*Pinus edulis*) during the recent drought and the 1950s drought; we sampled pairs of live and recently dead trees at three sites across a latitudinal gradient in New Mexico, and mined archival material for samples of trees that lived and died at the same sites during the 1950s drought. Growth indices from tree-rings were used to develop statistical models of mortality risk for trees across space and time. Growth indices were not strong predictors of mortality risk at two out of three sites sampled for trees that died during the 2000’s, although growth was a good predictor for the third site. Growth indices did a much better job capturing mortality risk during the mortality wave associated with the 1950s drought. These findings suggest varying drought-induced mortality mechanisms and thresholds through space and time, and they highlight the complexity as well as the potential of modeling tree mortality in semi-arid tree species using annual growth as a key predictor.



## May climate change driven ENSO droughts affect forest stability in Southeast Asia?

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Climate models predict an increasing frequency and severity of ENSO droughts caused by global warming. Our central objective was to study the sensitivity of trees in perhumid tropical regions to ENSO droughts. The main hypotheses were that natural forest trees are barely adapted to droughts, that wood density determines trees drought sensitivity, and that droughts affect forest stability in the study area. We installed three throughfall displacement roofs and three control plots (each 40m x 40m) in a premontane primary rainforest in the Lore Lindu National Park, Central Sulawesi. The roofs were closed for 2 years. The covered area was increased during the first year from 60 to 90% of the plot area. After 2 years of desiccation, we observed no significant reduction in tree leaf litter fall, fine root biomass and production. The radial stem increment after one year of desiccation did not decrease, but during the second year a significant reduction appeared. Tree height was found to be more decisive for the tree response to drought than wood density. The predominant Fagaceae *Castanopsis acuminatissima* forming the highest trees in the stand showed the greatest reduction in aboveground biomass increment, while the co-dominant tree *Platea excelsa* (Icacinaceae) showed no reduction at all. If climate model predictions come true this observed trend could provoke a shift in the competition and dominance structure of the studied premontane rainforest that may affect forest stability.



**Water relations of mature *Picea abies* under future CO<sub>2</sub> concentrations**

Sebastian Leuzinger<sup>1</sup>, Roman Zweifel<sup>2</sup>, Martin Bader<sup>3</sup>, Christian Körner<sup>3</sup>

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The ongoing rise in atmospheric CO<sub>2</sub> is expected to affect water relations not only at the plant/leaf level but also at ecosystem scale by reducing plant water consumption. In fact, most trees show some degree of water savings under future atmospheric CO<sub>2</sub> concentrations. Generally, responses are smaller in older vs. younger trees and in coniferous vs. deciduous trees. The amplitude of the stomatal response of adult forest trees under elevated CO<sub>2</sub> is highly species-specific. Therefore, predicting future catchment hydrology critically depends on our knowledge on water relations under elevated CO<sub>2</sub> of our most important forest tree species. While some data are available on mature deciduous trees, no data exist on naturally grown mature conifers. Here, we present data from five mature spruce trees (*Picea abies* L.) within a mixed deciduous forest stand in northern Switzerland that have been exposed to elevated atmospheric CO<sub>2</sub> during two growing seasons. In the first season, predawn water potential as well as stomatal conductance did not differ between treated and control trees. Combined analyses of Granier-type sap flow signals and electronic point dendrometers showed less than 5 % lower transpiration rates in CO<sub>2</sub>-treated trees, strongly depending on environmental conditions. A comprehensive analysis including the current growing season and pre-treatment comparisons will be presented from which general conclusions on the effect of species composition on future catchment hydrology can be drawn.



## Interaction between Douglas fir and European beech

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Douglas fir (*Pseudotsuga menziesii*) is supposed to be highly productive under the expected drier climate conditions in Central Europe. Forest management strategies aiming at risk minimisation promote mixed forests instead of well adapted tree species' monocultures. But for Douglas fir, growth tables or other experience of interaction with tree species indigenous to Central Europe are lacking. Douglas fir and European beech (*Fagus sylvatica*) are presumed to have similar ecological niches. At a study site in Pfälzerwald (Rhineland-Palatinate, Southwestern Germany), direct interactions between Douglas fir and beech are being investigated in pure and mixed stands. Above-ground competition effects are reflected in allocation patterns. Beech trees are higher and thinner in the mixed stand than in the pure one. In the mixed stand, above-ground productivity does not differ from pure stands, but beech produces a larger fraction of shade leaves than in the pure stand. Under interspecific competition, Douglas fir fine roots predominate in the uppermost soil layer where the nutrient availability is higher. On a soil-volume basis, beech fine root mass is lower in the mixed stand, and is displaced there into deeper, humus-poor soil layers. These results of interaction from neutralism to hampering effects indicate strong competition between the two species. In future vegetation periods, the water supply and the WUE of the species might be decisive for mortality or survival of individuals and stands.



## **Neighbourhood relations and influence of diversity and sloping terrain in a subtropical Chinese forest**

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There is an ongoing discussion on the mechanisms promoting the extraordinary species-richness in subtropical forests. Different theoretical approaches like Hubbell's neutral theory on the one hand and niche theory on the other are in discussion, yet empirical investigation lags behind. In particular, relatively little attention has been paid to test spatial mechanisms for coexistence. With increasing evidence that plant interactions are a spatially explicit process, the focus has to be shifted from the community toward the individual plants level and their local neighbourhood. The general aim of this study is to address the influence of species richness on tree growth at the individual and local neighbourhood level and to test if the diversity at the community level is the overall result of the diversity effects at the local neighbourhood level. Specifically, we related morphological growth responses and spatial arrangement of individual trees to their local biotic and abiotic environment. Target trees belonging to four different species were sampled together with their neighbours. Stem and crown dimensions of all individuals as well as their spatial arrangements were assessed. We analysed the influence of diversity and other biotic and abiotic variables (e.g. slope inclination) on the observed parameters. First results were biased and indicated that functional diversity had an impact on growth responses, though species-specific differences could not be detected.



**Repeller, attractor and neutral tree species in tropical rain forests**

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Although the role of species characteristics in maintaining tree diversity has been discussed for decades, spatial patterns in local diversity have not been analyzed from the viewpoint of individual species. To measure local diversity structures around individual species we propose the individual species-area relationships (ISAR), a novel spatial statistic which marries common species-area relationships with Ripley's K, to measure the expected  $\alpha$ -diversity in circular neighborhoods. We use ISAR to investigate if and at which spatial scales individual species increase in tropical forests local diversity (attractors), decrease local diversity (repellers), or behave neutrally. Our analyses of data from Barro Colorado Island (Panama) and Sinharaja (Sri Lanka) reveal that individual species leave identifiable signatures on spatial diversity, but only on small spatial scales. Most species showed neutral behavior outside neighborhoods of 20m. At short scales ( $< 20\text{m}$ ) we observed, depending on the forest type, two strongly different roles of species: diversity repellers dominated at BCI and accumulators at Sinharaja. Our results suggest that "balanced" species-species interactions may be a characteristic of these species-rich forests. We anticipate our analysis method will be a starting point for more powerful investigations of spatial structures in diversity to promote a better understanding of biodiversity in forests.



**Multi-scale spatial genetic structure of an understory shrub in subtropical evergreen broad-leaved forest***Xueqin Zeng*<sup>1</sup>, Walter Durka<sup>1</sup><sup>1</sup> Community Ecology, Helmholtz Centre for Environmental Research - UFZ

The study of the spatial genetic structure (SGS) which influences evolutionary and ecological processes can provide an understanding of the key processes and factors involved in the maintenance of viable populations. Within the BEF-China project we investigated *Ardisia crenata*, a self-compatible, widely distributed shrub species in subtropical evergreen broad leaved forest. We analyzed genetic variation and structure at the population and individual scale based on microsatellite data of 359 individuals from 12 populations. We also investigated biotic and abiotic habitat factors which we hypothesised to affect the genetic variation of populations. The results showed strong SGS at the level of both populations, as we found isolation by distance and restricted gene flow on the scale of 8 kilometers and at the scale of individuals ( $S_p=0.0168$ ,  $P=0.000$ ). This demonstrates that gene flow is non random across the study area. Moreover, the spatial autocorrelation analysis indicated leptokurtic gene flow, suggesting more restricted seed dispersal than pollen dispersal. We also found habitat factors to be correlated to both genetic variation and genetic structure. Population density, elevation, successional stage and tree density, which may influence genetic drift (via population size and bottleneck effects) and gene flow (via pollen and seed dispersal), were most important factors. Population density markedly affected SGS, strengthening the usefulness for a multi-scale approach.



**Forest regeneration dynamics in differently disturbed South African scarp forests**

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Human disturbance imperils biodiversity and ecological processes, such as seedling and sapling recruitment, which influence the long-term regeneration dynamics of forests. We assessed diversity of adult trees, saplings and seedlings as well as seedling and sapling recruitment in five representative types of differently disturbed scarp forests in KwaZulu-Natal, South Africa: 1) continuous natural forests, 2) natural forest fragments, 3) forest fragments in plantations, 4) forest fragments in agricultural matrix and 5) secondary forests. We identified all adult trees (diameter at breast height (dbh) >5 cm or >400 cm tall), saplings (dbh <5 cm, >75 cm tall) and seedlings (dbh <1 cm or <75 cm tall). Trees were sampled in a cross of two 30 x 10-m transects (500 m<sup>2</sup>). Within this cross we established ten subplots for seedlings and saplings in a checkerboard manner. We assessed seedlings in 10 x 1-m<sup>2</sup> subplots (10 m<sup>2</sup>) and saplings in 5 x 10-m<sup>2</sup> subplots (50 m<sup>2</sup>) including the seedlings' subplot. We will determine species richness, abundance, turnover, and composition of trees, saplings and seedlings. Furthermore, diversity and composition of trees surrounding the seedlings and saplings will be matched to connect offspring directly to parent trees and enable us to identify recruitment with possible external origin. These findings will help to evaluate whether isolated forest fragments and secondary forest rather act as population sinks or stepping stones in forest regeneration dynamics.



**Successional stages and species-specific traits influences on the response of old-growth temperate rainforests to climate change**

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Understanding how old-growth forests might respond to climate change is important because the large amount of carbon stored in their biomass. Old-growth temperate rainforests held the largest above ground biomass in the world. These forests may be sensitive to climate change because productivity in these regions is mainly constrained by temperature and radiation. Here, we developed an individual-oriented process-based forest model to analyze functioning of temperate rainforests of southern South America (42°S) under a climatic scenario expected for year 2100. We evaluated the model using field data from old undisturbed forests (N=13, >250 years-old) and identified the successional stage of studied stands. Around half of the studied forests were not in the old-growth stage, i.e. when forests have not reached steady-state. As a result of warming alone, all studied forests will become sources of carbon in the next century (-3.7 tonnes of carbon ha/year, overall average). The model predicted complex and variable patterns of carbon cycling among stands. Forest functioning under climate change in this region seems influenced by the long dominance of large pioneer trees. Because pioneer trees are common in forests in transition to the old-growth stage, successional stages of stands and species-specific traits are relevant to elucidate forest responses to climate change in this region.



## **The significance of intraspecific trait variability in modelling forest growth**

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Climate change is expected to affect species composition and stand structure of forests both through changes in mean values of e.g. temperature and precipitation, and through an increase in extreme events. The response of species to climatic change is mediated by their functional traits. These traits vary not only between species, but exhibit variation within species. The effect of this intraspecific trait variation on forest dynamics has been little studied so far.

Here we focus on two growth limiting traits that are expected to be particularly relevant in the context of climate change: a) the required annual temperature sum and b) drought tolerance. Using a range of data sources like dendrochronological time series and forest inventories, we quantify the intraspecific variation of these traits for key European tree species. We then integrate this quantified intraspecific variation in the forest landscape model LandClim to evaluate the effect of intraspecific variability on forest succession of exemplary forest ecosystems under climate change scenarios.



**Constant functional diversity during secondary succession of a subtropical forest in China**

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Trait-based approaches in biodiversity ecosystem functioning (BEF) research assume that an increasing complementarity should be reflected in a higher divergence of species-specific characteristics. This divergence of traits can be expressed by measures of functional diversity (FD). It is generally assumed that in forest succession ecosystem complexity increases with time, and thus, that FD should increase. We present a study carried out within the BEF-China Research Unit in Gutianshan (Zhejiang, China), where 27 (30 x 30 m) Comparative Study Plots (CSPs) were established along five successional stages. Out of the total of 148 woody species encountered in the CSPs, a set of 36 traits was obtained for 120 species. Against expectation, we failed to detect any trend in functional diversity as described by Rao's quadratic entropy FDQ. FDQ was maintained at a constant level during succession, although the mean distance of all traits in the community (i.e. trait dissimilarity TDQ) converged. We found that the community compensated for a loss in trait dissimilarity TDQ by distributing the remaining traits more evenly among the resident species, thus increasing functional evenness FEQ. As a consequence, a constant functional diversity is maintained in this subtropical forest during succession. Furthermore, null models for FD showed that the trait sets of the different species were equivalent, which might provide an explanation for the observed increase of species richness with time.



## **Estimation of biomass and NPP in Tugai Forests of Central Asia**

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Based on field investigations within Tugai-forests (Amu Darya, Turkmenistan and Tarim, Xinjiang), dendrochronology and biometric formulas the standing biomass of riparian ecosystems in Central Asia is estimated. An upscaling of the presented results using remote sensing is planned.



## Productivity of trees in deciduous temperate forests related to different climatic conditions

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Understanding the relation between changing climate and productivity-diversity relationship of forests is fundamental for developing strategies for carbon sequestration, particularly because Central-European forestry converts monospecific into mixed stands. We investigated deciduous forest trees in three stands differing in tree species diversity to examine if (i) mixed stands are more productive than monospecific stands, (ii) how tree species differ in the productivity of stem wood, leaves and fruits. We found distinct differences between the tree species regarding total and seasonal production of biomass. Seasonal growth dynamics of *Tilia* were dependent on the prevailing climatic conditions with slow stem wood increment in cool and moist spring. *Fraxinus* exhibited the highest wood production and reached 60-80% of its annual increment at the end of June. *Fagus* had a higher frequency of mast years in the last decade, with fruit mass exceeding foliage mass. The observed differential seasonal growth patterns among the species did not result in increased productivity at the plot level. *Tilia*, *Acer* and *Carpinus* invest more carbon into the production of foliage and enhance carbon cycling in mixed species stands, whereas the higher production of stem wood in *Fagus* trees results in longer carbon storage in trees in monospecific stands. Our data suggest that above-ground net primary production is more under the control of tree specific traits than dependent on tree species diversity.



**Will the CO<sub>2</sub> fertilization effect in forests be offset by reduced tree longevity?***Harald Bugmann*<sup>1</sup>, Christof Bigler<sup>1</sup><sup>1</sup> Forest Ecology, ETH Zürich

Experimental studies suggest that tree growth is stimulated in a greenhouse atmosphere, leading to faster carbon accumulation (i.e., higher rate of gap filling). However, higher growth may be coupled with reduced longevity, thus leading to faster carbon release (i.e., higher rate of gap creation). The net effect of these two counteracting processes is not known. Here, data on maximum growth rate and maximum longevity of 141 temperate tree species are used to derive a relationship between growth stimulation and changes in longevity. We employ this relationship to modify the respective parameter values of tree species in a forest succession model and study aboveground biomass in a factorial design of growth stimulation × reduced maximum longevity. The results show that (1) any growth stimulation at the tree level leads to a disproportionately small increase of stand biomass due to negative feedback effects, even in the absence of reduced longevity; (2) a reduction of tree longevity tends to offset the growth-related biomass increase; at the most likely value of reduced longevity, the net effect is very close to zero in most multi- and single-species simulations; and (3) when averaging the response across all sites to mimic a “landscape-level” response, the net effect is close to zero. We conclude that any CO<sub>2</sub> fertilization effect is likely to be offset by a reduction in the longevity of forest trees, thus strongly reducing the carbon mitigation potential of temperate forests.



## Forest management and gastropod diversity

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Broadleaved forests are the natural vegetation cover of the temperate region. Forest use can be assumed to (have) impact(ed) the litter-dwelling fauna on a large scale by altering food availability (e.g., conifer plantations) and decreasing habitat heterogeneity (e.g., deadwood removal). These effects are exemplified for gastropods. Conifer plantations only support an impoverished subset of the species from broad-leaved forests. Within forests, downed deadwood interacts with the leaf litter layer and is associated with locally decreased microclimatic fluctuations, increased soil quality, and increased carrying capacity. A potential rescue effect from alternative refuges is visualized both on a local scale, namely a historical charcoal-ore mining site, and on the landscape scale. The latter approach focuses on the regional distribution pattern of the forest specialist *Limax cinereoniger*, and illustrates possible relations between climate, forest fragmentation and management, and geomorphological background complexity. While reforestations (and aided recolonization) may help to sustain or reestablish forest specialists, deforestations can have long-lasting cryptic effects. For example, populations of the forest-associated snail *Discus rotundatus* from old-growth and reforested sites differ in shell features (likely reversible) and population genetic structure (probably persistent).



**Effects of tree diversity on insect herbivory in subtropical forests of southeast China**

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Insect herbivory can strongly affect ecosystem processes. However, little is known about plant diversity–herbivory relationships from complex ecosystems, such as forests, particularly over gradients of high plant diversity. We analyzed insect herbivory on saplings of ten tree species across forest stands differing in age and tree diversity in phytodiverse subtropical forests in China. We tested whether plant diversity influences folivory in these forests or whether other factors are more important at high levels of phytodiversity. Leaf damage was assessed on 1284 saplings, together with structural and abiotic stand characteristics. Herbivory increased with plant diversity even after accounting for effects of stand characteristics, of which stand age-related aspects most clearly covaried with herbivory. Density dependence or other abiotic factors did not significantly affect overall herbivory. The positive herbivory–plant diversity relationship indicates that effects related to resource concentration theory, which predicts reduced damage by specialist herbivores as host plant concentration decreases with increasing plant diversity, do not seem to be major determinants of herbivory in our phytodiverse forests. An explanation for our findings, which, however, requires further testing, might be a higher impact of polyphagous species than traditionally assumed for such species-rich forests, as generalist herbivores can profit from the dietary mix provided by high plant diversity.



**Comparison of the biocoenosis of oribatid mites as indicators for soil biodiversity (Oribatida, Acari) in beech and spruce forest stands in the Eifel National Park.**

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Oribatid mites belong to the species- and individual-richest group of microarthropods in soil. With their wide range of nutrition, mainly as detritivores and microphytophagous, they are directly and indirectly involved in the soil biological decomposition processes. One management strategy in the Eifel National Park is to convert existing spruce forest to beech forest (Luzulo-Fagetum), the potential natural vegetation. Oribatid mite communities can be used to evaluate the forest conversion with the concurrent alteration of biodiversity. Therefore this investigation should build the prerequisite by characterizing the reference communities of oribatid mites in beech and spruce forest stands in the Eifel National Park. Thus three spruce and beech forest replicates were chosen and in every single one three 25x25 m investigation sides were placed. In each investigation side two litter and two soil samples were taken. One sampling was performed in spring and another one in autumn 2009 with a soil core sampler (Ø 5cm, height 5cm). The microarthropods were extracted from leaf and needle litter and from the upper 5 cm of soil in the MacFadyen-Extractor. In total, 144 samples of litter and soil were taken and the oribatid mites were determined on species level. Furthermore, the correlation between species composition and factors like vegetation, litter overlay, pH-value, C/N- and water content was analysed to establish the base for the ecological analysis of forest conversion.



## **The impact of forest management on ground-dwelling invertebrates: A subtropical – temperate contrast**

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Temperate and tropical arthropod communities are assumed to differ but empirical studies are rare. We studied the effect of land use intensity on arthropod assemblages in subtropical southern Brazil and Germany. Arthropods were sampled in different forests types ranging from native undisturbed forests (Araucaria respectively Beech) to a highly managed intense monocultures of non-native and alien species (Eucalypt and spruce, respectively). The main results of our study are that while there were differences between the subtropics and the temperate forest in the occurrence of particular taxa, total abundances of the different groups were surprisingly similar. Land use had different effects on abundances and diversity in the subtropical vs. the temperate region, while there was a decrease in abundances in the subtropics, there were no significant differences for most variables in the temperate zone. Overall, increasing land use intensity did not dramatically affect invertebrate abundances. Different feeding guilds tended to show similar responses to land use but responses differed between regions. In the subtropics, abundances of guilds decreased with increasing land use intensity, while in the temperate region the opposite pattern was found. Predator-prey ratios were similar along the land use intensity gradient in both regions they increased over the first three levels of intensity but decreased at the highest level.



**Climate versus habitat structure: Drivers of arthropod communities in spruce canopy**

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Abundance and diversity of arthropods depend on climate, habitat structure and biotic interactions. In terrestrial ecosystems, habitat structure is usually a function of the plant community, which is again largely determined by climate. Therefore, arthropods that feed on plants are affected by climate along a direct and an indirect path. Accordingly, the relative importance of climate for arthropod communities should decrease with a decreasing dependency on plants. Based on this line of arguments, we evaluated the relative importance of climate versus forest structure for the composition of arthropod communities in Norway spruce (*Picea abies*) canopies along an elevation gradient. Overall, we sampled 192 species with more than 31'000 individuals. Species were assigned to feeding guilds (carnivores; fungivores; xylophages; phytophages) and to generalists, conifer specialists, and spruce specialists. The importance of variables characterizing climate (e.g. temperature) and forest structure at three spatial scales (tree; stand; landscape) for the composition of these guilds was estimated using variance partitioning based on redundancy analysis. Our results revealed for all arthropods that forest stand structure and climate had significant independent contributions on community composition (explained variance: 23%; relative independent effects of stand structure 37%, climate 27%). Although climate (38%) was more important than stand structure (17%) for phytophages, there was no evidence for the predicted decrease in the relative importance of climate from phytophages to carnivores or from spruce specialists to generalists. Our results showed that climate and forest structure are of almost similar importance for the composition of communities of canopy arthropods. Climate variables may therefore be insufficient to predict the response of arthropod communities to climate change. Furthermore, forest management decisions have the potential to compensate negative effects of climate change on biodiversity.



**Spatiotemporal variation of true diversity: Doubling the estimate of canopy spider richness in temperate forest**

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Estimating biodiversity patterns is a fundamental task of the scientist working to support conservation and management decisions. Most biodiversity studies are carried out only over a short period of time and it is assumed that they are representative of general patterns. However, if there is significant temporal heterogeneity in the biodiversity pattern being studied, the time frame of samplings could lead to a serious under- or overestimating of diversity and might result in contradictory conclusions. Here we analyze the gradients of arboreal spider diversity and species richness on European beeches, in terms of spatial (canopy strata) and temporal (seasonal) variables. The highest alpha diversity was found in the old-growth beech canopy and in spring, while the lowest alpha diversity was found in young beeches and in the autumn, when the community structure consisted of a small number of dominant species together with species of low frequency. Overall, spatial and temporal similarities were only 45% and 20-25%, respectively, which indicates a significant spatiotemporal turnover in species richness. If we combine samples from high canopy strata and non-summer seasons we could double the asymptotic species richness and increase true diversity. With our data, we have demonstrated that spatial and temporal variations should be taken into account when studying biodiversity patterns.



## **The structure of forest soil food webs across a land-use gradient**

*Ulrich Brose*<sup>1</sup>

<sup>1</sup> Georg-August Universität Göttingen

The complex soil food webs of different beech and coniferous forests were assembled under the framework of the Biodiversity Exploratories. The network structure of these communities was described by the populations and their trophic interactions. Subsequent analyses tested for significant differences in the network structure between (1) forests of the different land-use types (e.g., beech forest age classes) and (2) these forest soil food webs and those from aquatic or terrestrial aboveground ecosystems. These analyses of network topology provide a necessary step towards a mechanistic understanding how human land-use affects the biodiversity and subsequently the functioning of forest soil ecosystems.



**Computational prediction of food-web interaction strengths in an experimental forest floor community***Florian Schneider*<sup>1</sup>, Ulrich Brose<sup>2</sup><sup>1</sup> Institut für Zoologie, Technische Universität Darmstadt<sup>2</sup> Institut für Zoologie und Anthropologie, Georg August Universität Göttingen

The recycling mechanism of litter is a process of essential relevance for the persistence of all terrestrial ecosystems. This process is provided by a complex food web. It is characterized by a generalist predator community with frequent intra-guild predation. These predators carry out an indirect control of the litter decomposition rates while feeding on the decomposer community. However, their net effect is masked due to intra-guild predation. To identify the relevant species for the recycling process, knowledge of the quantitative distribution of interaction strengths within the food web is required. Allometric Foraging Theory is a promising concept to estimate food web topology and interaction strengths from the bodymass of predator and prey. To test it, we constructed experimental food webs in microcosms with meso- and macrofaunal invertebrates and compared multi-predator food webs against predator knockout-treatments. This design yields quantitative interaction strengths of each predator on all components of the food web. In computational simulations we used biomass based differential equations with allometric scaling constants to predict the quantitative interaction strengths. The model includes a general bodymass-dependent functional response, parameterized in a preliminary 24h microcosm experiment. If this model succeeds in predicting the interaction strengths it can be applied to simulate the effects of species loss on the ecosystem function of decomposition.



POSTER PRESENTATIONS:**Micro-site variation and beetle extraction efficiency: Studying factors influencing comparative biodiversity surveys in the Eifel National Park**

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These studies investigated factors, which might substantially influence results obtained by comparative biodiversity surveys aiming to evaluate the response of the litter fauna during spruce to beech forest conversion. The leaf litter fauna was sampled in an “old-growth” beech (120 yrs) and spruce (80yrs) forest using the Winkler technique. We focused on (1) the effect of tree distance on the faunal composition in old beech and spruce stands, and (2) the extraction time for selected taxa from leaf litter of both forest types. Preliminary results for the micro-site variation on genus level revealed that (1) significantly more individuals were obtained in samples taken near tree trunks in a beech forest; however, no meaningful differences could be observed in the spruce forest, and (2) the genus composition differed notably between beech and spruce forest and between samples taken at the two micro habitats in both forest types. The cumulative extraction curves (30 min - 21 days) for spruce and beech litter showed no differences for Aranaea, Opiliones, Diplopoda and Chilopoda; but, longer extraction times for Coleoptera and Isopoda from beech litter. The data obtained recommend an extraction time of 6 days for a comparative extraction of macro-arthropods from spruce and beech litter. Our results suggest that sampling method and design influence the data obtained from different forest litter samples and thus has to be considered carefully when comparing litter faunal assemblages between different forest ecosystems.



## Hydrochorous diaspore dispersal in a restored river mouth area

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Species-rich alluvial forests became rare in Europe. Many of these systems were highly degraded by a conversion to arable land. Restoration of degraded alluvial systems requires the re-establishment of a flooding regime both to facilitate the creation of gaps for plant colonization and to allow the hydrochorous input of diaspores. Within the framework of a larger research project on plant re-colonization processes within a floodplain forest restoration project, here, we present first results of our studies on hydrochorous diaspore input 14 months after restoration. The study area is located at the mouth of the Kyll river, which discharges into the Moselle River (Western Germany). This area is extremely poor in target species (actual vegetation, soil seed bank, aerial seed rain). In the course of restoration, several flood channels were excavated as an initial measure after land abandonment. To test the significance of these channels as a structure that helps to mitigate diaspore limitation, we installed floating diaspore traps and astroturf mats (diaspore sedimentation) at the entrances and within the channels. In February 2010, two successive high-flow events were studied. Species spectra and the numbers of trapped diaspores varied considerably between floodwaters and locations.



## Identifying effects of tree diversity and tree identity on nematode community composition

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Understanding processes influenced by biodiversity is one of the great challenges of current ecological research. We examined the impact of tree diversity and tree identity on nematode community structure in deciduous forests of different tree diversity. Clusters of groups of three trees were identified differing in the composition of tree species. Target tree species were beech (*Fagus sylvatica*) and ash (*Fraxinus excelsior*) differing strongly in physiology, litter quality and mycorrhizal type, as well as lime (*Tilia cordata* and *T. platyphyllum*). Diversity had no significant effect on total nematode density, but in trend the density was at a maximum in the most diverse clusters. Further, tree species identity had strong positive or negative effects on certain nematode trophic groups. Ash beneficially affected bacterial feeding nematodes, whereas fungal feeding nematodes were suppressed. The opposite pattern was true for beech by beneficially affecting fungal feeders and detrimentally affecting bacterial feeders in the clusters dominated by beech. Lime in general negatively impacted nematode density, but did not affect nematode trophic structure. Other trophic groups, such as plant feeders, predators and omnivores, were not affected by tree diversity or tree species identity. Generally, beech and ash strongly impacted the trophic structure of nematode communities suggesting that tree identity may result in major shifts in the channelling of energy through decomposer food webs.



## Impact of shallow landslides on forest dynamics in a south Ecuadorian montane forest

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Shallow landslides are a major source of natural disturbance in tropical montane forests. Due to shallow landslides vegetation and often the upper soil are removed, leaving space for a quasi primary succession. This is also the case in our study site, the *Reserva Biológica San Francisco* in the Andes of South Ecuador. The terrain is characterized by deeply incised valleys and steep slopes. Approximately 4 % of the area is covered with visible traces of landslides. In order to investigate the interaction of vegetation and landslide dynamics we have utilized an individual based, spatially explicit simulation model of forest growth for this montane forest. We study how landslides affect forest structure and regeneration and investigate the effect of landslides on the carbon dynamics. Our simulation results show that it takes at least 40-50 years, until a forest structure similar to the pre-landslide state establishes, but the composition of tree species differs from the composition in a mature forest for much longer periods of time (~400 years). Landslides induce carbon losses, when the sliding material is decomposed and/or transported out of the system via water streams. On the other hand, carbon is sequestered by growing trees throughout the forest succession. Our modelling approach allows to estimate the magnitude of these effects and to gain a better understanding of the role of landslides in this complex forest system.



## **Bark beetle outbreak patterns: A theoretical study of the evolution of dispersal distances and aggregation strength**

*Klara Dolos*<sup>1</sup>, Alexander Kubisch<sup>2</sup>, Emanuel A. Fronhofer<sup>2</sup>, Thomas Hovestadt<sup>2</sup>, Björn Reineking<sup>1</sup>

<sup>1</sup> Biogeographical Modelling, University of Bayreuth

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Bark beetle outbreaks are of high socio-economic relevance since such events may cause severe damages to a wide array of economically important tree species. Here we focus on the emergence of spatio-temporal outbreak patterns of this biotic forest disturbance at a landscape scale. The life history of bark beetles is highly sensitive to temperature and therefore susceptible to climatic change. Thus, bark beetle outbreak dynamics are likely to change and predictions of severity and frequency of such events are challenging. A better understanding of the population dynamics would support the development of effective management strategies.

With a strategic individual-based model we aim to analyse emergent dispersal, aggregation and infestation patterns. In our model the dispersal distance and aggregation strength of individual beetles are subject to evolution. Thereby, we can determine optimal dispersal and aggregation parameters and identify the basic processes that are relevant to explain the observed infestation patterns. Results of this project will be integrated into the bark beetle module of the forest landscape model LandClim.



## Influence of tree diversities on root system development

Silke Gerhardt<sup>1</sup>, Jens Wöllecke<sup>1</sup>

<sup>1</sup> Brandenburgische Technische Universität Cottbus

As part of the tree diversity experiment Kreinitz near Riesa (Saxony), performed by the Helmholtz Centre for Environmental Research - UFZ, the influence of tree diversity (different mixtures with *Fraxinus excelsior*, *Tilia cordata*, *Quercus petraea*, *Fagus sylvaticus*, *Pinus sylvestris*, *Picea abies*) on root system development was investigated. In autumn 2005, two times 49 plots at 25 sqm with 30 different tree arrangements were planted. In April 2010, soil samples were extracted from the 5, 6 and 1-species treatments. The soil cores were divided into depths of 0 to 5 cm and 5 to 10 cm. Later the samples were stored in a cool place until the following laboratory investigations.

In the laboratory the roots were extracted from the samples, washed and counted. The living root tips were analysed regarding their mycorrhizal status. Results are to provide information on how the tree diversity influences the root system development. First results showed increasing branching of fine roots and mycorrhization on plots with different tree species compared to the 1-species plots.



## **Effect of spruce to beech forest conversion on epigeal beetle assemblages in the Eifel National Park**

*Maike Guschal*<sup>1</sup>, Philipp Hopp<sup>1</sup>, Martina Roß-Nickoll<sup>1</sup>

<sup>1</sup> Institute for Environmental Research (Bio 5), RWTH Aachen (Rheinisch westfälische technische Hochschule Aachen)

Because of economical demands, native beech forests (Luzulo-Fagetum) have been replaced by coniferous stands in many parts of Germany. In order to restore native forest ecosystems, the Eifel National Park attempts to set basic conditions for the establishment of beech forests through planting of beech trees in spruce forests as well as the clearance of spruce forests. The objective of our investigation was to study the effect of spruce to beech forest conversion on the abundance, diversity and assemblage composition of litter-dwelling beetles. Beetles were sampled in 15 stands across 5 different forest types (mature beech forest, mature spruce forest, mix stands with (i) >15 years old and (ii) ~ 5 years old beech plantings, wind breaks) using the Winkler technique. Preliminary results are: (1) Study sites on wind breaks show the lowest beetle abundances of all study sites. (2) Mature beech forests show significantly higher abundances than spruce forests and wind breaks, respectively. (3) Mixed stands show higher abundances than spruce forests; however, the differences are not significant. (4) The beetle family composition is significantly different between beech and spruce forests. Further results will be provided and include comparisons of species density and species composition between all studied ecosystems as well as a detailed examination of the relationship of beetle diversity and composition to environmental factors.



**Canopy arthropod assemblage: Do the spider diversity and composition change with growth of European beech trees?**

*Samuel Yu-Lung Hsieh*<sup>1</sup>, Karl Eduard Linsenmair<sup>1</sup>

<sup>1</sup> University of Würzburg

While the majority of studies on arboreal arthropod communities was stimulated by the excitement about the tremendously rich biodiversity and complex structure of these communities in the canopies of lowland tropical rainforest trees, those of the temperate forests were neglected for a long time. Here we focus on the diversity of arboreal spiders in the canopy strata of an European beech forest in Würzburg University Forest, Germany, demonstrating a prominent relationship between spider diversity and age classes of trees (Old-growth: over 150 years old; mature: 50-60 years old; young: 20-25 years old). Although mature beeches harbour on average six times the abundance of old-growth beech canopies, both age classes possess a higher alpha diversity than young beeches. Spider guilds of mature and young trees are more similar than those of old-growth canopies, and the Fisher Alpha index have shown a decreasing pattern in the temporal dynamic of diversity indices among years. Our results demonstrate that biodiversity of spiders of the temperate forest canopies, being a nearly as big white patch on the biological map as the arthropod canopy fauna of tropical forests, merits far more attention and needs to be accurately revisited by duly taking into consideration also the age of trees, not only young versus old-growth but also the age of mature trees.



**Regeneration of *Ocotea usambarensis*, a key tree species in montane forests in East Africa, is still inhibited 10 years after logging**

Fritz Kleinschroth<sup>1</sup>, Arne Cierjacks<sup>1</sup>, Ingo Kowarik<sup>1</sup>, Caspar Schöning<sup>2</sup>, James Kung'u<sup>3</sup>

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Mount Kenya holds some of the last forest resources in Kenya. Uncontrolled logging resulted in an alarming decrease of the key tree species *Ocotea usambarensis* which should be counteracted by the strict prohibition of forestry activities in 2000. To analyze stand dynamics and safe sites for germination, we studied sexual and asexual regeneration at 50 study plots in areas differently influenced by selective logging. Our study revealed that only half of the study plots showed sexual regeneration. Higher irradiance along with a low herb cover correlated with a significantly higher seedling number. In contrast, asexual regeneration was observed in the majority of the plots. Remaining trees at logged sites showed a significant lower number of root suckers than in areas less influenced by logging. *Macaranga kilimandscharica* proved to be an indicator for forest disturbance. Both sexual and asexual regeneration of *O. usambarensis* decreased with higher *Macaranga* abundance. We conclude that 10 years after the end of logging activities, tree recruitment is still inhibited. Our data indicate that exclusion from utilization alone will presumably not ensure sufficient natural recruitment of *O. usambarensis*. As in the other remaining forests in East Africa there is an urgent need for efficient restoration schemes which take the ecological requirements of target species and the needs of the human population into account.



## How does intraspecific variability translate into decomposition processes?

*Hanno Müller*<sup>1</sup>, Martin Zimmer<sup>1</sup>, Harald Auge<sup>2</sup>

<sup>1</sup> FB3: EÖ-B (AG Zimmer), IFM-Geomar Kiel

<sup>2</sup> Department of Community Ecology, UFZ Halle

Monocultural practice in forestry has long been criticized for various reasons. Based on a long-term field study with different diversity levels of experimentally planted trees, we add to this in that we show how intraspecific variability in leaf litter quality from mono- versus mixed-species plots translates into decomposition processes. Over time, feeding by woodlice promoted mass loss of ash litter from mixed-species plots more than of ash litter from mono-species plots: after two months, leaf litter from mixed cultures had lost 20 % more mass, suggesting that nutrient release into the soil will be more pronounced in mixed stands than pure stands. Thus, besides other advantages, mixing tree species in plantations may improve the nutrient availability to growing trees.



**Community assembly mechanisms in forest herb layer communities along gradients of fertility and disturbance***Tobias Naaf*<sup>1</sup><sup>1</sup> Institute of Land Use Systems, Leibniz-ZALF

Plant community assembly from the regional pool is largely driven by two mechanisms: environmental filtering and niche partitioning resulting in trait convergence or divergence, respectively. It is still unclear under which circumstances each of the two assembly patterns is prevalent. I studied community assembly mechanisms in herb layer communities of temperate forest patches in NW Germany at two different levels: the regional level using a multiplicative diversity partitioning approach, and the community level looking at distributions of competitive and reproductive traits along gradients of fertility and disturbance. At the regional level, most competitive traits were divergent while most reproductive traits were convergent. Despite a remarkable species turnover, functional turnover was low, suggesting ecological redundancy among communities. At the community level, canopy height tended to converge towards taller species with increasing soil fertility and light availability. Most reproductive traits tended to diverge with increasing degree of disturbance and fertility. This study demonstrates that competitive traits (here canopy height) can be convergent under environmental favorability, but this convergence is associated with a divergence of traits related to other challenges (here reproduction). I conclude that looking on trait distribution patterns at the regional level might mask community assembly mechanisms confined to certain parts along environmental gradients.



## Modeling the diversity of forest types in the Bavarian Alps

*Birgit Reger*<sup>1</sup>, Ralf Schüpferling<sup>1</sup>, Jörg Ewald<sup>1</sup>, Elke Dietz<sup>2</sup>, Christian Kölling<sup>2</sup>

<sup>1</sup> University of Applied Sciences Weihenstephan-Triesdorf

<sup>2</sup> Bavarian State Institute of Forestry

Mountain areas often exhibit high forest ecosystem diversity due to strong ecological gradients (e.g. water, temperature, nutrients). Despite of the ecological importance of mountain forests, area-wide information (forest site maps) is scarce due to high field mapping costs. In our project ([www.winalp.info](http://www.winalp.info)) we developed an approach to systematically assess the distribution of forest types in the Bavarian Alps. We define forest types as hypervolumes in ecological space that give rise to forest communities with comparable species composition, structure, production and protective functions. We compiled layers of geodata (digital elevation model, geological maps, soil maps, climate model) at scale 1:25.000 for the whole region as well as georeferenced point data of high quality (soil profiles, vegetation plots). We used average Ellenberg indicator values for temperature (T), moisture (F) and acidity (R) of vegetation plots as summary parameters of plant responses to ecological gradients and calibrated models that allow to predict gradient positions of each raster cell in the region from geodata layers. The three-dimensional system of gradients was partitioned into forest types, which can be mapped for the whole region. Our approach combines the strength of GIS, bioindication and vegetation modelling and delivers an intermediate-scale map of potential natural vegetation that will be integrated in a forest information system and used to effectively manage and protect forest stands.



**Study of floristics, life form and chorology of plants in the east of forests, Iran**

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Iran is one of the most important centers of biodiversity in the old world. About 22% of the total 8000 plant species are endemic to Iran. Therefore, study of the flora and vegetation is important. The northern forests of Iran are diverse ecosystems of Euxine-Hyrcanian province in Euro-Siberian region and Holarctic kingdom. Floristic Study of a habitat is valuable for continuing ecological research, management and conservation of plants. Richness and diversity of plants and various forest types in Guilan, 80 km to south of Sari, make it a unique habitat to study floristically. The eastern forests of Guilan, with the area of about 8000 ha., is located in the at 37°, 05' to 37°, 11' north latitude and 50°, 00' to 50°, 14' east longitude. The altitude is varied from 500 to 1000 m. The mean annual precipitation is 406 mm. Plant species collections were performed in May, June and November of 2007. The species were identified and their chorology and life form were determined. The results revealed the existence of 158 plant species, belonging to 5 families of Pteridophytes and 52 families of Angiosperms. Most of species belong to Asteraceae, Poaceae and Fabaceae, Lamiaceae, Rosaceae, respectively. According to Raunkiaer's classification of life forms, Hemicryptophytes, Therophytes and Phanerophytes, include 46%, 19%, 17%, and 4% of the total species, respectively. Chorotypes, based on Zohary, showed that most of the species belong to province Hyrcanian and Euro-Siberian-Mediterranean-Irano Turanean regions.



**Birch forest plant diversity of the Kazbegi region (the Central Caucasus)***Nato Tephnadze*<sup>1</sup><sup>1</sup> Ilia State University

Subalpine crook-stemmed birch forest floristic composition was studied in the Kazbegi region. The main aims of the research were: 1) Investigation of plant diversity in the birch forest and treeline ecotone; 2) Monitoring of the natural restoration of the subalpine forest in the region. 21 study plots were selected in the natural and close to natural birch forest and in the treeline ecotone on three different massifs (Kvena Mountain, Kuro ridge and river Snostskali left-side ridge) in the following river gorges: Tergi, Snostskali and Chkheri. Four plots are located on the Kuro massif; three in the river Snostskali gorge and 14 on the Kvena Mountain, in Lifu forest. On the two of these plots observation on the forest restoration process was conducted. High taxonomic diversity of vascular plants was revealed in the studied phytocoenoses: 167 species, 103 genera and 40 families. Subalpine birch forest treeline plant diversity (Shannon-Wiener index) is higher than plant diversity of birch forest at lower elevations and shows correlation with the phytocoenosis structure and substrate. Floristic comparison of the plots exhibited low similarity (Ji: 0.1 – 0.4). Observation on the birch forest natural restoration showed that this process is effective and fast.



**Soil mineral nitrogen status along a successional forest gradient in subtropical China**

*Stefan Trogisch*<sup>1</sup>, Jin-Sheng He<sup>2</sup>, Andy Hector<sup>3</sup>, Michael Scherer-Lorenzen<sup>1</sup>

<sup>1</sup> Faculty of Biology, Geobotany, Albert-Ludwigs-University Freiburg, Germany

<sup>2</sup> Department of Ecology, Peking University, China

<sup>3</sup> Institute of Evolutionary Biology and Environmental Studies, University of Zurich, Switzerland

Within a recently initiated biodiversity ecosystem functioning experiment (BEF China), we investigated the influence of successional stage and woody plant species diversity on nitrogen (N) and carbon (C) cycling in natural subtropical broad-leaved forest stands. We aimed to identify impacts of stand age and tree diversity on biogeochemical transformation processes and pool sizes of N and C. Our study was conducted in the Gutianshan National Nature Reserve located in Zhejiang Province, East China. In 2008, 27 permanent vegetation plots were established in three successional forest stages ranging from early (<20 years) to late successional (>80 years). Total N and C as well as seasonal changes of plant available ammonium ( $\text{NH}_4^+$ ) and nitrate ( $\text{NO}_3^-$ ) were measured in the mineral soil for five depth increments. In parallel, we determined net N mineralization rates in the upper 10 cm of the mineral soil by in situ incubation of soil cores. Soil mineral nitrogen and net mineralization rates showed a clear seasonal pattern with the highest values during summer and lower values in the other seasons. Soil C and N concentrations were significantly influenced by successional forest stage. C concentration increased during succession whereas total N was highest in young forests and lowest in middle-aged forest stands. Our first results indicated pronounced changes in N and C dynamics in the course of secondary succession and strong seasonal fluctuations of mineral soil N concentrations.



## Diversity patterns of ferns along a climatic gradient in Bolivian Amazonia

*Patrick Weigelt*<sup>1</sup>, Felix Normann<sup>2</sup>, Michael Kessler<sup>3</sup>, Hanna Tuomisto<sup>4</sup>, Karsten Wesche<sup>5</sup>, Kalle Ruokolainen<sup>4</sup>

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<sup>5</sup> Senckenberg Museum of Natural History Görlitz

We investigated local fern species richness and turnover in relation to spatial and environmental variables in Bolivian Amazonian rainforests. Along a c. 1000 km long climatic gradient, we sampled fern species on 24 transects of 5 m x 500 m in size. Variation partitioning revealed that the variation in both local species diversity (39.9 %) and species turnover (23.4 %) could to a large degree be explained by environmental variables alone. The explanatory power of the geographic position alone was low (1.4 % in both cases), suggesting that fern species distributions in Bolivian Amazonia are mainly driven by environmental factors rather than random dispersal or local extinctions. Precipitation, elevational heterogeneity, and the distance to the Andes turned out to be the most important factors for explaining the variation in local species diversity. Precipitation-related variables, especially seasonality, and variables concerning temperature contributed to explaining species turnover. The great importance of precipitation for the observed diversity patterns might be explained by the typically high water dependence of ferns and by trade-off mechanisms between drought-resistance and growth. Our results have important implications for nature conservation in the light of climate change. Due to varying floristic composition, protected areas should cover entire precipitational gradients and include exceptionally wet areas as potential refugia.



## Rootsystem development in mixed stands

Jens Wöllecke<sup>1</sup>, Silke Gerhardt<sup>1</sup>

<sup>1</sup> Lehrstuhl für Bodenschutz und Rekultivierung, Brandenburgisch Technische Universität Cottbus

The investigation of root development in mixed stands is part of the Kreinitz-Experiment where the effects of tree and litter diversity on species interactions and ecosystem functions were observed in 49 combinations in two replicates. In plot of 25 m<sup>2</sup> 30 trees (*Fraxinus exelsior*, *Tilia cordata*, *Quercus petraea*, *Fagus sylvaticus*, *Pinus sylvestris*, *Picea abies*) were planted in 2005. Two soil cores per plot were taken in 2009 and the holes were filled with soil again and used as “ingrowth cores” for the following sample dates. A second sampling of these cores was done after one year in 2010. The extracted roots were categorized into dead and living roots. Root tips were counted and their mycorrhizal status was analysed. The mycorrhizae were characterized in a first step by morphotyping. For rootsystem characterization the roots were scanned and the root length was analysed by image analysis. Additionally, root dry mass was measured. The root samples are still under preparation and first results will be presented.



## SESSION 04 – HIGH MOUNTAINS BIODIVERSITY AND ECOLOGY

CONVENOR: DIETMAR SIMMERING

ORAL PRESENTATIONS:

### **Identifying regions with similar spatial conditions for the European Alps and their surroundings**

*Caroline Pecher*<sup>1</sup>, Erich Tasser<sup>1</sup>, Ulrike Tappeiner<sup>1,2</sup>

<sup>1</sup> Institute for Alpine Environment, European Academy Bozen/Bolzano (EURAC), Italy

<sup>2</sup> Institute of Ecology, University of Innsbruck, Austria

In many environmental studies, the selection of representative case-study areas is required. Especially in heterogeneous regions like the European Alps and their surroundings, the identification of study areas can be challenging. At first, similar regions need to be determined, facilitating the selection. Therefore, the objective of the presented study was to identify regions with similar spatial conditions for the cooperation area of the Alpine Space Programme. The method applied within this study is applicable to any other region in the world. In a first step, 20 indicators on topography, landscape composition, landscape pattern, and road accessibility were selected and calculated for 17 504 municipalities. Only pan-European base data on land use and land cover, elevation, roads, and municipal areas were used. The indicator results were aggregated by means of a Principal Components Analysis, applying the Varimax rotation. The extraction of the components was based on Eigenvalues greater than 1. The five resulting components explain 67.5% of the total variance. Component 1 represents large forest areas, component 2 large and higher elevated semi-natural and natural areas, component 3 the abandonment of agricultural areas, component 4 remote regions, and component 5 topographical aspects of the study area.



**Patch configuration affects alpine plant distribution***Karl Hülber<sup>1</sup>, Stefan Dullinger<sup>1</sup>*<sup>1</sup> Vienna Institute for Nature Conservation & Analyses

The relative importance of niche requirements and dispersal limitation in controlling the landscape scale distribution of plants is still contentious. Local occurrence and abundance of alpine plants are commonly thought to be driven by abiotic site conditions due to steep environmental gradients. However, explicit tests on the additional role of dispersal-related processes for alpine plant distribution patterns are lacking. Here, we combine niche-based species distribution models with variables describing patch size and connectivity to evaluate if spatial habitat configuration affects the occurrence and abundance of six snowbed plant species at the northeastern Calcareous Alps in Austria. Moreover, we assess if eventual effects of spatial patch configuration are more clearly detectable when calculating connectivity based on parameterized mechanistic dispersal kernels instead of using common nearest neighbour metrics. We show that patch size and connectivity are correlated to both occurrence and abundance patterns. In addition, connectivity measures derived from parameterized dispersal kernels were more closely related to species abundance patterns, than a simple nearest neighbour metric. We conclude that, despite evident abiotic limitations, recurrent local extinctions and delayed re-colonizations indeed play a role for the distribution of study species, and that alpine plants may hence be less in equilibrium with their abiotic environment than commonly thought.



## Treeline dynamics in response to climate change in dry and mesic regions of the central Himalaya, Nepal

Krishna Shrestha<sup>1</sup>, Annika Hofgaard<sup>2</sup>, Vigdis Vandvik<sup>1</sup>

<sup>1</sup> Department of Biology, University of Bergen

<sup>2</sup> NINA, Norway

In the past decades, temperature has increased in the Himalayas, following the global trend. We studied changes in the treeline ecotone in central Himalaya, focusing on tree-ring chronologies, age structure and recruitment of two conifers. The study was performed in two sites: a mesic north-facing slope at Lauribinayak (28°07'N, 85°21'E) where the treeline is formed by *Abies spectabilis* and a semi-arid south-facing slope at Ngawal (28°41'N, 84°00'E) where the treeline is formed by *Pinus wallichiana*. At each site, three transects across the forest line, treeline and krumholtz line were established, and trees, saplings and seedlings were sampled. We explored relationships between past climate variability and tree growth, establishment and age structure along the transects. The growth response to climatic variability differed between sites. Growth was positively correlated to summer temperature and negatively correlated to pre-monsoon precipitation in the mesic site, and negatively correlated to mean winter temperature and December precipitation in the semi-arid site. Recruitment was not affected by climate in the mesic site, but was positively correlated to February precipitation in the semi-arid site. Our results suggest that both temperature and precipitation affect treeline dynamics and that responses are moderated by the regional and local environment.



**Regional differentiation in life history and susceptibility to grazing in a widespread Alpine monocarp**

J.F. (Niek) Scheepens<sup>1</sup>, Eva S. Frei<sup>1</sup>, Jürg Stöcklin<sup>1</sup>

<sup>1</sup> Botanical Institute, University of Basel

Glacial history caused regional differentiation in neutral markers in numerous widespread Alpine plant species. Several distinct phylogeographic lineages resulted from the glacial survival in refugia and subsequent recolonisation of different parts of the Alps. These historic processes could also have affected phenotypic trait differentiation among these regions, whether through drift or regional adaptation. A two-year common garden experiment with the monocarpic *Campanula thyrsoidea* from 21 populations across the European Alps was performed to reveal quantitative trait differentiation among populations of four phylogeographic regions. A clipping treatment was applied to simulate herbivory. Clear regional differentiation was observed in the common garden. Plants from the Eastern Alps were differentiated from the other regions in their phenology, showing delayed and indeterminate flowering. Compared to the short growing season of the high Alps, this contrasting flowering behaviour of Eastern Alpine plants indicates adaptation to the long submediterranean summers in the native range in Slovenia. In plants from the Western Alps, clipping resulted in a less pronounced, and sometimes even positive, response of reproduction compared to the clearly negatively affected plants from the other regions. This suggests a lower susceptibility to grazing in the Western Alps, which could explain why *C. thyrsoidea* occurs more frequently in grassland in this region.



**Quantitative genetic differences in growth, reproduction and leaf morphology mirror phylogeography in a widespread Alpine plant**

Eva S. Frei<sup>1</sup>, J.F. Scheepens<sup>1</sup>, Georg F.J. Armbruster<sup>1</sup>, J. Stöcklin<sup>1</sup>

<sup>1</sup> Institute of Botany, University of Basel

From the perspective of preserving biodiversity, it is important to understand how historic processes affect contemporary genetic pattern in widespread plant species. Numerous studies demonstrated the impact of glacial history on molecular geographic structure in alpine plants. However, studies testing whether regional molecular differentiation at the large scale of the Alps is mirrored as well in quantitative genetic differentiation in phenotypic traits are lacking so far. Here, we studied molecular differentiation and in parallel quantitative genetic differentiation among 18 populations of the widespread Alpine plant *Geum reptans*. In a common garden experiment including 592 plants, we recorded quantitative genetic differences among regions, populations and genets. In parallel, the 128 genets used in the common garden were analysed with molecular markers to detect a putative molecular geographic structure, to measure genetic diversity and to estimate gene flow among regions and populations. We detected a distinct molecular differentiation splitting the Alps in 3 phylogeographic regions indicating restricted gene flow among regions. Furthermore, a strong isolation by distance indicates the importance of neutral drift during isolation in glacial refugia. In the common garden regional effects on quantitative traits concerning growth, reproduction and leaf morphology were consistently larger than differences due to populations and genotypes, thereby indicating that glacial history has also affected phenotypic differentiation.



## SESSION 05 - SCALING UP – SOIL BIOTA AND GLOBAL ELEMENT CYCLES

CONVENOR: LILIANE RUEB

ORAL PRESENTATIONS:

### **From genes to ecosystems – Nitrogen turnover as an example**

*Michael Schlöter*<sup>1</sup>

<sup>1</sup> Terrestrial Ecogenetics, Helmholtz Zentrum München

So far one of the best studied nutrient cycles in soils is the turnover of nitrogen. This is mainly related to the fact, that nitrogen is strongly linked to soil health, as all biota require nitrogen for growth and mainly in natural ecosystems the availability of ammonia and nitrate is still considered as the bottleneck for growth and activity of most organisms present. The genes, which catalyze the different reactions, have been well described in many cases and regulation pathways are well understood in pure cultures. However if the data published so far based on single isolates can be transformed to complex microbial communities in soil, where still a large part of the microbes are not known or only described by phylogenetic markers, is more than unclear. For example the discovery of ammonium oxidizing archaea has changed the picture about nitrification completely. Whereas at the beginning of the century it was believed that only some autotrophic  $\beta$ -proteobacteria are able to catalyze the transformation of ammonia to nitrite, today we are faced with a completely new group of organisms that perform the same transformation step, obviously under different environmental conditions and different regulatory pathways. This leads to questions of general ecological relevance like “functional redundancy” “resilience” or “niche differentiation” of these two groups. In the presentation different examples will be shown, how microbes act as architectures of the soil at small scales and how this influences soil health on larger scales.



**Biochar use in soils: A mitigation strategy for greenhouse gas emissions?**

*Claudia Kammann*<sup>1</sup>, Ludger Grünhage<sup>1</sup>, Christoph Müller<sup>1</sup>

<sup>1</sup> Department of Plant Ecology, Justus-Liebig-University Giessen

Terra Preta research revealed the positive effects that black carbon additions can have on infertile tropical soils, ranging from increased water holding- and cation exchange-capacity to yield increases, increased soil microbial biodiversity and respiratory efficiency. Hence, biochar use seems to be a win-win-win strategy to combat various global challenges. However, it is crucial to evaluate possible side effects on the greenhouse gas balances (GHG: CO<sub>2</sub>, N<sub>2</sub>O, CH<sub>4</sub>) after char application, since GHG reductions may add to the value of biochar use while GHG emission stimulation will reduce it. Although it has often been mentioned that biochars could reduce N<sub>2</sub>O emissions there is not much experimental evidence available. We evaluated various biochars (pyrolysis) and hydrochars (hydrothermal carbonization) for their effects on GHG fluxes in a series of pure-soil and plant-soil experiments. Biochar additions reduced N<sub>2</sub>O emissions significantly with or without plants, respectively, even following N-fertilization. In contrast hydrochar reduced N<sub>2</sub>O emissions first but stimulated them significantly after N-fertilization. CO<sub>2</sub> emissions tended to be reduced with biochar and stimulated with hydrochar, respectively. Interestingly, wetted pure bio- and hydrochars tended to emit CH<sub>4</sub>, however, the emission quickly declined and was minimal compared to the changes in N<sub>2</sub>O fluxes. In conclusion, biochar seems to be an interesting option for mitigating GHG emissions from agricultural soils.



**Biochar use in soils: Establishment of reproducible toxicity tests for biochars (pyrolysis) and HTC-biocoals from hydrothermal carbonization**

Daniela Busch<sup>1</sup>, Claudia Kammann<sup>1</sup>

<sup>1</sup> Institut für Pflanzenökologie, Justus-Liebig Universität Giessen

Addition of carbonaceous organic materials to soils is currently discussed as an option to improve soil fertility and enhance C sequestration. However, before a broad scale application can be considered, possible influences on ecosystem functions and environmental conditions should be evaluated. A series of toxicity tests were established to test if biochars affected germination and early plant development in *Lactuca sativa*, *Hordeum vulgare* and *Lepidium sativum* and avoidance behaviour of earthworms (*Eisenia foetida*). The study of short-term effects on biological organisms, based on ISO guidelines or standardized tests used for compost evaluation, shall provide information about possible influences of phytotoxic gases, toxic substances or toxic effects on soil fauna associated with application of biochars or HTC-biocoals. In a first step, the reproducibility of the test procedures was evaluated using the same biochar (peanut hull, Eprida, USA). Furthermore, earthworms tended to avoid one HTC-biocoal while showing no negative response to another one. In contrast, significantly higher earthworm numbers were found in biochar-containing compartments. Furthermore, first results of genotoxicity tests with two carbonaceous substances with *Tradescantia* plants will be presented.



**Biochar use in soils: Eco-physiological plant responses to biochar use in a poor sandy soil**

Sebastian Linzel<sup>1</sup>, Johannes Goessling<sup>1</sup>, Claudia Kammann<sup>1</sup>, Hans-Werner Koyro<sup>1</sup>

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Global warming and increasing desertification of soils urgently demand innovative solutions for all these threatening problems. Terra Preta research demonstrated that charred organic material in infertile tropical soils may have various positive effects, ranging from increased water holding capacity and cation exchange capacity to yield increases and even to an increased soil microbial biodiversity. Thus, the application of biochar to soils may be a promising adaptation strategy to combat global warming. To our knowledge, no study so far investigates plant eco-physiological reactions to biochar application to help understand positive effects. Therefore we investigated the effect of three levels of biochar addition and two water treatments to a sandy soil on growth, water use efficiency and eco-physiology of *Chenopodium quinoa* Willd in a greenhouse study. With biochar application, *Quinoa* showed a high water use efficiency, despite a significantly larger leaf area. Aboveground plant respiration was significantly reduced with BC application; neither soil- nor plant-soil-respiration was increased, despite larger BC-grown plants. N<sub>2</sub>O emissions were significantly reduced by BC-application. We conclude that biochar use in poor sandy soils may provide multiple benefits, including reduced GHG emissions.



**Rhizobial plants do it better (but smell worse) - Belowground mutualists favour growth and defence**

*Martin Schädler*<sup>1</sup>, Daniel Ballhorn<sup>2</sup>

<sup>1</sup> Department Biozönoseforschung, Helmholtz Centre for Environmental Research, UFZ

<sup>2</sup> University of Minnesota

By fixation of atmospheric nitrogen rhizobia enhance growth of legumes and are important drivers of plant productivity and diversity. However, their influence on plant-herbivore interactions is largely unexplored. Using White clover and Lima bean as model systems we investigated the effects of rhizobial colonization on plant growth, herbivore performance and plant defence by cyanogenesis. We show that rhizobia do not only increase plant growth but also enhance plant defence by cyanogenesis, thereby reducing feeding by insect herbivores for both plant species. For acyanogenic plants of White clover, however, rhizobia increased herbivore performance. Further, rhizobial colonization strongly mediated the production of herbivory-induced volatile organic compounds in Lima bean. Whereas the induction of many compounds was decreased on rhizobial plants, the emission of N-containing indol increased. We show that this leads to a higher attractiveness of non-colonized plants for a specialist herbivore. Plant growth was always increased with rhizobia. Our results show that belowground mutualists may attenuate a possible trade-off between growth and nitrogen-based defence mechanisms in legumes.



**Biological soil crusts: response to short- and long-term disturbance and their global relevance**

*Bettina Weber*<sup>1</sup>, Burkhard Büdel<sup>1</sup>

<sup>1</sup> Plant Ecology and Systematics, University of Kaiserslautern

Biological soil crusts (BSC) are formed by an intimate association of cyanobacteria, algae lichens, mosses and fungi in varying proportions, that colonize the uppermost millimeters of the soil. They occur in arid and semiarid regions worldwide or wherever comparable microclimatic conditions exist. Based upon morphological and taxonomic features, seven BSC types could be distinguished. Overgrazing over longer time-periods was found to hamper the development of climax crusts over several years. After a single small-scale experimental disturbance, however, an initial BSC of the original extent had formed already after the first rainy season (6 months). 18 months after disturbance, chlorophyll contents and surface stability revealed no significant differences anymore when compared to control sites. The relevance of biological crusts (comprising crusts growing on soil, rocks and plants) with regard to the global nitrogen and carbon cycle was estimated on the basis of interpolations using the existing literature data. According to these calculations, biological crusts account for approx. 7% of the terrestrial net primary production of carbon and 16-46% of the biological nitrogen fixation.



POSTER PRESENTATIONS:**Detritivorous activity of the terrestrial isopod *Armadillidium vulgare* in laboratory microcosms**

Bérénice Bois<sup>1</sup>, Gael Freyssinel, Benjamin Bourdon, Freddie-Jeanne Richard, Catherine Souty-Grosset

<sup>1</sup> Ecology Evolution Symbiosis - UMR CNRS6556, University of Poitiers

Agricultural practices modify the composition of species leading to a lower ecosystem functioning. Among the soil fauna, terrestrial isopods are key species because of their detritivorous activity. Our objective was to evaluate the impact of *Armadillidium vulgare* on litter and soil processes by studying the transfer of calcium, carbon and nitrogen from the litter to the soil and consequences on pH and conductivity. This was investigated in laboratory microcosms with 6 types of soil (and corresponding litter) sampled in the Plaine Mothaise where the isopods diversity is studied in cultivated plots and permanent meadows. We measured Ca concentration in the humus made during the experimentation, as well Ca, pH and conductivity at 5 cm depth. Increasing hygrometry shows that soils were not washed and that microcosms were well designed. In microcosms with *A.vulgare*, pH became less acid, conductivity and Ca decreased, since ions were driven down by water, suggesting their important role for ions dynamic in soil. No differences in acidity, conductivity, and Ca were observed -excepted for the case of forest- which shows that the feeding-activity of *A.vulgare* was not disturb by the different environments. Effectively the gain of weight in isopods was similar in all microcosms.



## Effects of protozoan grazers on microbial carbon fluxes in the detritosphere

*Maïke Hünninghaus*<sup>1</sup>, Robert Koller<sup>1</sup>, Susanne Kramer<sup>2</sup>, Sven Marhan<sup>2</sup>, Ellen Kandeler<sup>2</sup>,  
*Michael Bonkowski*<sup>1</sup>

<sup>1</sup> Terrestrial ecology, University of Cologne

<sup>2</sup> Soil science and evaluation, University of Hohenheim

Decomposition of organic matter is crucial for ecosystem function. Microorganisms, responsible for mineralization and recycling of nutrients are usually treated as a homogeneous functional guild. However, there is strong evidence that microbes differ in mineralization capacity. In addition, a significant part of the microbial community is top-down controlled by microbial grazers, such as protozoa. Since protozoan grazing is highly selective and selectivity differs among species, we hypothesised that protozoa specifically affect microbial decomposer diversity and function. We tested the effects of different protozoa on mineralization rate of maize litter in arable field soil by using two species each of the following functional groups: flagellates, ciliates and amoeba. Protozoan grazers caused a significant increase in microbial mineralization. Effects of protozoan diversity, number and identity of functional groups and effects of specific species are discussed in respect to CO<sub>2</sub>-production over time (as measure of the microbial mineralization process) and grazing induced changes in microbial biomass and community composition (measured by phospholipid fatty acid analyses).



**Decomposer richness effects on plant productivity: Predominance of sampling effects aboveground and complementarily effects belowground**

Britta Merkel<sup>1</sup>, Stefan Scheu<sup>1</sup>, Nico Eisenhauer<sup>1</sup>

<sup>1</sup> Georg-August-Universität Göttingen

Soil fauna represents an important component of terrestrial ecosystems, e.g. by driving decomposition processes. To date few studies investigated to which extend ecosystem functions depend on the diversity of soil organisms and existing results are inconsistent. In a microcosm experiment we manipulated decomposer diversity (0, 1, 2 and 4 species) and type of fertilizer (mineral and organic) to investigate effects on plant productivity. Test organisms were wheat, two earthworm and two Collembola species. We determined total plant, shoot, root and spike biomass et al.. Fertilizer types had no significant effect on plant productivity. The earthworm species *Lumbricus terrestris* beneficially affected all aboveground parameters. Both Collembola species reduced the biomass of aboveground plant parts. Total and root biomass increased significantly with number of decomposer species. In total plant biomass this was due to the presence of *L. terrestris* (sampling effect), underlining its relevance as key decomposer species. Our results also show that impacts of decomposer richness on plant performance, i.e. root productivity, were not only based on sampling effects, but also relied on decomposer complementarity. While sampling effects predominated on aboveground plant parts, decomposer complementarity governed root productivity. Our results question the common view of belowground functional redundancy and highlight the importance of decomposer richness for ecosystem multifunctionality.



## Primary succession in a post mining area in Lower Lusatia – A soil-zoological investigation

Cornelia Reißmann<sup>1</sup>, Daniel Einfalt<sup>2</sup>

<sup>1</sup> Chair of Soil Protection and Recultivation, Brandenburg University of Technology Cottbus

<sup>2</sup> University of Ulm

Primary succession is one of the first steps during the development of a post mining area. Small-sized organisms like bacteria, amoebae, nematodes and springtails are transported by wind to the freshly-exposed substrate. Their availability in the soil is absolutely necessary for different soil processes for example the initialization of the nutrient cycle.

On a field experimental site we investigated the abundances of different organism groups (micro- and mesofauna) subject to five different vegetation treatments: litter of *Lotus corniculatus* and *Calamagrostis epigejos*, natural vegetation, *L. corniculatus* and control (no vegetation). Soil samples were taken after one year (49 weeks). Nematodes, tardigrades, springtails and mites were extracted by Baermann and MacFadyen and determined quantitatively.

Our results show that the abundances of nematodes and springtails are dependent on the different vegetation treatments. Nematodes are more abundant in treatments with *L. corniculatus* and in substrate enriched with litter of *C. epigejos* in contrast to the other treatments. Springtails show higher abundances with *L. corniculatus* compared to natural vegetation.



## SESSION 06 – LANDSCAPE ECOLOGY AND BIOGEOGRAPHY

CONVENOR: INGO HAHN, DUCCIO ROCCHINI

ORAL PRESENTATIONS:

### **Global diversity of island floras: Species richness, endemism and threat**

*Holger Kreft*<sup>1</sup>, Wilhelm Barthlott<sup>2</sup>, Pierre L. Ibisch<sup>3</sup>, Walter Jetz<sup>4</sup>, Gerold Kier<sup>2</sup>, Tien Ming Lee<sup>5</sup>, Jens Mutke<sup>2</sup>, Christoph Nowicki<sup>3</sup>

<sup>1</sup> Georg-August-Universität, Göttingen

<sup>2</sup> University of Bonn

<sup>3</sup> FH Eberswalde

<sup>4</sup> Yale University

<sup>5</sup> University of California, San Diego

Islands are popular model systems in ecology and biogeography and research on island has prompted some of the most influential theories in ecology and evolution. However, the knowledge about the global scale distribution of vascular plant diversity on islands is still insufficient. Moreover, environmental and historical correlates of diversity as well their underlying mechanism are to date heavily debated. Here, we present an overview of recent progress of global plant diversity on islands. We demonstrate that the number of plant species on an island can be well predicted by a few and simple abiotic characteristics (area, isolation, temperature, precipitation, topography, geology). A multi-predictor model comprising these six variables accounts for 85% of the variation in a global set of 488 islands also accounting for the overall lower richness of island floras. In a second step, we looked at endemism richness – a measure that combines endemism and species richness. Despite their overall lower species densities, islands have a significantly higher concentration of species' ranges and contribute significantly to the world's biodiversity. Our analysis reveals that island biotas are currently more heavily threatened by human activities than mainland regions. Future projections of land use change suggest that habitat loss might even accelerate on islands as compared to mainland areas. We conclude that island conservation should be a top priority in global conservation efforts.



**Reproduction and island endemics: Nest ecology and conservation of landbirds of the Juan Fernandez Islands, Chile**

*Ingo Hahn*<sup>1</sup>, *Pablo Vergara*<sup>2</sup>

<sup>1</sup> Inst. f. Landschaftsökologie, Westf. Wilhelms-Universität Münster

<sup>2</sup> Inst. of Geo-Engineering; Univ. Santiago de Chile

The nesting ecology of the landbirds of the Juan Fernandez Islands, Chile is analyzed. Differences are detected between the single islands as well as between endemic and invasive taxa. Hypotheses according to brood ecology are investigated that focus on related taxa on the Chilean mainland. We found that endemic island birds show lower nest site diversity than mainland birds, produce larger eggs, do not produce larger clutch sizes, but show indications for a reduced reproduction rate as well as show increased behavioral tameness. For reason of nature conservation, further investigations on reproduction success of Juan Fernandez Firecrown and Masafuera Rayadito are urgently needed.



**Vegetational diversity in a hyper-karstic, hyper-humid oro-Mediterranean environment**

*Pavle Cikovac*<sup>1</sup>, Christian Bräuchler<sup>2</sup>

<sup>1</sup> Landwirtschaftskammer NRW

<sup>2</sup> Department Biology I, Faculty of Biology, LMU Munich

The Balkan Peninsula has one of the richest floras of the Western Palearctic with high levels of endemism and diversity of biota. Main nodes of the regional biodiversity are mountain systems close to coastal zones. Due to greater variety of climatic and geologic features mountain systems have higher percentages of endemism and form separate biogeographical islands that through ecological isolation facilitated speciation, formation of local vegetation types and with vertical movement of plants during climatic oscillations enabled survival of relictic species. A geographically isolated massif and most diverse center of the SE-Dinaric alps is Mt Orjen. Due to position and topography rainfalls exceed 5000 mm, Europe's maximum, but hyper-humid conditions combine to xeric karst geomorphy. Climate and combinations to limestone substrates promote a transitional zone of xerophilous mediterranean and mesophilous temperate flora that distincts Orjen from neighboring Dinaric ranges. Xerophytes of oro-Mediterranean origin are prevalent in calcareous grasslands, scree and rock communities and xeric coniferous forests of distinct SE-Dinaric alliances. The resilient hyper-karstic ecotopes and minor severe glaciations, especially during the last LGM, were important factors for the diverse flora, where vegetation influences never were unidirectional but with the isolation of fragmented karstic landscapes and specific ecological conditions favored formation and survival of endemic populations.



**Analyzing biodiversity using landscape metrics in strategic environmental impact assessment studies***Matthias Pietsch*<sup>1</sup><sup>1</sup> FB 1, Hochschule Anhalt (FH)

In strategic environmental impact assessment studies (SEIA) biodiversity is one of the topics that have to be analysed and evaluated in the different planning steps (scoping, environmental impact study, monitoring) while the Convention on Biological Diversity (CBD) has been implemented in the environmental impact assessment act. Based on the CBD biodiversity has to be analysed for habitats, species and genetic aspects. At the moment practical methods are missing. Therefore methods have to be developed to depict the whole topic. Landscape metrics are an effective tool to analyse the composition and arrangement of landscapes at different levels (patch, class, landscape). They are well-known in landscape ecology and tested for different purposes in a lot of studies all over the world. They are based on the patch-corridor-matrix model and in the last few years extended to the gradient model to take 3D-aspects (elevation) and continuous changes in consideration.

Based on the requirements of the planning process in SEIA and the CBD Landscape metrics are used in case studies to qualify the planning results. Based on the experiences a proposal for a useful set of LSM will be made to help planners to regard the topic biodiversity in a better way in the future.



## Projected and observed changes of vascular plant species richness at the landscape scale in Switzerland

*Hiltrud Brose*<sup>1</sup>, Matthias Plattner<sup>2</sup>, Ingolf Kühn<sup>3</sup>, Michael Nobis<sup>1</sup>

<sup>1</sup> Biodiversity and Conservation Biology, Swiss Federal Research Institute WSL

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<sup>3</sup> Department of Community Ecology, Helmholtz Centre for Environmental Research UFZ

The potential impact of environmental change on species richness is primarily investigated by projecting and adding up individual species distributions or by directly projecting species richness. The reliability of these projections is of great interest to conservation ecologists and policy makers, but validation is difficult as appropriate data are widely lacking.

In this study, projections of species richness for the year 2050 are compared to short-term observed changes within a 5-year period. Using data from the Swiss Biodiversity Monitoring (BDM; [www.biodiversitymonitoring.ch](http://www.biodiversitymonitoring.ch), transect data per 1 km<sup>2</sup>, N=447 square kilometres), we focus on species richness of certain vascular plant groups based on indicator values and biological traits at the landscape scale. Generalized linear models are used to correlate species richness with environmental variables and the impact of environmental change is analysed using scenarios for climate warming as well as for land use change. By comparing the projected changes in species richness for the different groups to real changes observed in a shorter space of time, it will be demonstrated how meaningful the projections are and which trends might already be visible in the short-term observations. Additionally, the use of certain species groups for evaluating the impact of environmental change will be highlighted.



**Impacts of habitat fragmentation on woodland species in consideration of landscape metrics***Britta Eggers<sup>1</sup>, Raul Köhler<sup>1</sup>*<sup>1</sup> Institute for World Forestry (vTI)

In our central European man-made landscape more and more habitats become destroyed or fragmented because of the increasing anthropogenic need of available land and despite of the growing knowledge about the problem. Roads, residential, and industrial areas separate formerly connected habitats into small remnants and thus create small subpopulations. Especially stenotopic species with low dispersal power are endangered because exchange of specimen between different habitat patches is reduced or entirely inhibited. Methods for the quantification of fragmentation are necessary to develop management and species-specific conservation plans for habitat networks. In this project we investigate the structure of the German woodlands by calculating landscape metrics and study the impacts of fragmentation on different FFH-species' occurrences. Indices which quantify the fragmentation of woodlands are identified by using a simulation model of neutral landscapes. A niche model of different species is calculated to show the impacts of woodland fragmentation on different woodland species. These models will then be used to expose potential habitats which are not colonised yet. Furthermore, we analyse the suitability of the abovementioned structure metrics to predict the occurrence of threatened species.



**Landscape connectivity for biodiversity: Testing indices, improving approaches**

*Guy Pe'er*<sup>1</sup>, Lucia Schober<sup>2</sup>, Klaus Henle<sup>1</sup>, Karin Frank<sup>3</sup>

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Landscape connectivity affects the viability of species in fragmented landscapes and their response to land-use and climate changes. However, tools are lacking for predicting functional connectivity. We tested the capacity of different indices to predict functional connectivity, using an Individual-Based Model as a reference for functional connectivity, and a landscape generator for producing virtual landscapes differing in landscape structure. We simulated home-range movements and dispersal movements of hypothetical forest bird species that differ in their response to forest edges, over 40 landscapes ranging from 5 to 50% forest cover. Model outputs were compared to several indices of structural connectivity: forest cover, number of patches, distance to nearest neighbor, landscape shape index, and landscape cohesion. Model results were also compared to a more sophisticated index driven from graph theory, Probability of Connectivity (PC). We found that the performance of the structural indices was medium to low, especially with respect to dispersal movements. Particularly bad was the performance of forest cover. PC performed far better, but its relation to model results changed with forest cover. We compare the range of applicability of the various indices, and provide some tools and guidelines for conversion between them. Thereby, we contribute to the better implementation of these indices for conservation planning and biodiversity conservation in fragmented landscapes.



## Hedge-forest connectivity and crop-field neighbourhood affect bee and hoverfly diversity

*Sebastian Haenke*<sup>1</sup>, Anikó Kovács<sup>2</sup>, Péter Batáry<sup>1</sup>, Birgit Meyer<sup>3</sup>, Teja Tscharntke<sup>1</sup>, Andrea Holzschuh<sup>4</sup>

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Local insect diversity and related ecosystem services in linear landscape elements like hedgerows might be influenced by both connectivity between hedges and forests and by the crop type in the adjacent field. In the current study we selected 12 forest edges, 12 hedges connected to forests and 12 isolated hedgerows. Half of the study sites were adjacent to winter wheat and half were adjacent to oilseed rape fields. Hoverflies (Syrphidae) and bees (Apoidea) were sampled by sweep-netting along 200 meter transects in hedges and forest edges, and in adjacent crop fields. During oilseed rape flowering, adjacent oilseed rape fields led to an increase in bee and hoverfly species richness and abundance, indicating that these important pollinators and bio-control agents benefited from nectar and pollen resources provided by mass-flowering oilseed rape. After oilseed rape flowering, more bees and hoverflies were found in the forest edges and hedges than in the crop fields probably due to alternative food resources. Furthermore, hoverfly abundance and species richness were highest in forest edges, and higher in connected than in isolated hedges after oilseed rape flowering. Our results emphasize the importance of conserving hedgerows and forest edges in the agricultural landscapes as they provide important alternative food resources for pollinator and pest controlling insect communities.



**Could homogeneous sylviculture provide biodiversity in a modified agricultural landscape?**

*Gael Freyssine*<sup>1</sup>, Damien Deschamps<sup>1</sup>, Benjamin Bourdon<sup>1</sup>, Roland Raimond<sup>1</sup>, Catherine Souty-Grosset<sup>1</sup>

<sup>1</sup> Ecology Evolution Symbiosis - UMR CNRS6556, University of Poitiers

This project focuses on the impacts of sylviculture on regional biodiversity in a highly structured landscape mosaic with small plots. The study site is the flooding "Plaine Mothaise" (Western France), where economic and agronomic interests (water availability, soil fertility, topography...) led to the replacement of more than 25% of the flooded grasslands by poplar plantations and crops during these last 10 years. We evaluated ground beetles (Coleoptera – Carabidae) diversity and activity-density because of their taxonomic and ecological variation, and their sensitivity to the environment. From May to October 2009, we sampled both poplars and neighbouring habitat (grassland, crop, woodland, hedgerow, fallow land). Poplar's carabid diversity is studied considering habitat characteristics at plot and landscape scales. Results showed that from 87 species sampled in the whole area, 49 were observed in poplar plantations. Among poplars' species, 82% are found in at least another habitat. More than increasing species richness, poplar plantations seem to play an important role as habitat refugia. First habitat analyses of the cultivations exhibit the importance of management type, poplar age, and their impacts on botanical sub-layer. Links with landscape data will be taken into account for management implication favouring local and regional biodiversity.



## **Agricultural landscape diversity and landscape function**

*Zdzislaw Bernacki*<sup>1</sup>

<sup>1</sup> Department of Environmental Biology, Institute of Agricultural and Forest Environment  
PAS

For function and stability of landscape not only species composition but also structural diversity is important. Agricultural landscape like every landscape is heterogenic system composed by different kinds of ecosystems but usually it's much simplified.

Structural diversity of landscape affect many important ecological processes:

- Species diversity: plants, fungi, insects and birds species number
- Microclimate conditions: wind speed, evapotranspiration, soil and air temperature, frosts frequency
- Soil properties: moisture, N and P content
- Soil erosion
- Organic matter decomposition rate
- Ground and surface water contamination level
- Agricultural production and net primary production

The paper describes results used in mosaic agricultural landscape, near Turew village (West Poland). The study showed that diversified agricultural landscape keep species diversity, is more resistible for disturbances and can even mitigate global changes.



**Dispersal traits in grassland plant communities are related to the historical landscape**

*Oliver Porschke*<sup>1</sup>, Martin T. Sykes<sup>1</sup>, Peter Poschlod<sup>2</sup>, Honor C. Prentice<sup>3</sup>

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The ability to disperse in space and time determines the response of plant species to landscape fragmentation and local disturbance. Using fourth corner analysis, we directly linked species' dispersal and persistence traits in grassland plant communities to the history of local management and the landscape context. Highly significant associations between long-distance dispersal potential and historical landscape configurations and/or long-term grazing management suggest that long-distance dispersal processes are no longer effective in the present-day landscape.



## **Plant species richness and composition, changes over a 100 year period in the Swedish archipelago – A landscape study**

*Elsa Aggemyr*<sup>1</sup>, Sara A. O. Cousins<sup>1</sup>

<sup>1</sup> Department of Physical Geography and Quaternary Geology, Stockholm University

Studying plant species communities in a temporal context extending over a 100 year period gives us a unique opportunity to analyse long term changes. In this study, we had access to 100 year old plant species data from 48 islands in the Stockholm archipelago and we have re-surveyed 27 of these. The overall objective was to analyse the distribution of present-day plant species richness and 100 year of species turnover in relation to the island biogeography theory. Historical maps from 1901, aerial photos from 1952 and 2004 was analysed in a GIS to interpret land-cover changes. Since 100 years ago all grassland management has ceased and semi-open forests have become denser. Today there are many summer cottages on the islands. The results confirms the island biogeography theory but by including anthropogenic induced land-cover changes the accuracy of the prediction models for species richness, extinctions and colonisations increases. Surprisingly, total species richness has increased over the period. Furthermore, a shift in plant species composition towards more nitrophilous species is evident. During the last hundred years an extensive species turnover has occurred resulting in a plant community shift beneficial for strong competitors associated with habitats in later succession stages.



**Seed bank and seed rain a rural landscape mosaic***Alistair Auffret<sup>1</sup>, Sara Cousins<sup>1</sup>*<sup>1</sup> Department of Physical Geography and Quaternary Geology, Stockholm University

Semi natural grasslands are among Europe's most species rich habitats, but modern agricultural change has placed them under threat. The potential for restoration might however exist, thanks to remnant plant populations in abandoned grasslands and small remnant habitats, and the reintroduction of grazing in former arable fields. This study empirically investigated the potential contribution of seed banks and seed rain in the restoration and conservation of grassland plant populations in the rural landscape, and to see if samples taken at the landscape scale could give a general and meaningful overview, despite the known small scale variability in seed distribution. We took 30 seed bank samples, and placed 30 seed traps in ten replicates of grazed semi-natural grasslands, grazed former arable fields, mid-field islets and abandoned semi-natural grasslands in a 36km<sup>2</sup> landscape in southern Sweden. Plant species occurrence at each site was also investigated. Seed bank and seed rain samples were planted in a greenhouse assess their germinable seed content, from which 54 376 seedlings of 188 species emerged. Above ground vegetation was found to be a generally poor predictor of seed bank and seed rain in all habitats. The presence of grassland specialists in the bank and rain samples of abandoned grasslands and grazed former arable fields where they were not present in the vegetation implies a recolonisation potential for grassland communities at large temporal and spatial scales.



**Strong genetic differentiation at regional scale despite of an outcrossing mating system in the common grassland species (*Geranium pratense*)**

Stefan Michalski<sup>1</sup>, Walter Durka<sup>1</sup>

<sup>1</sup> Department of Community Ecology (BZF), UFZ–Helmholtz Centre for Environmental Research

The use of local provenances in restoration, agriculture and forestry has been identified as measure to sustain biological diversity and to improve local productivity. However, the delineation of local provenances is challenging because it requires the identification of well defined groups based on spatio-genetic differentiation and/ or the evidence of local adaptation. Such patterns are expected to be scale-dependent and to be strongly effected by the amount of gene flow present. In this study we investigate genetic variation at AFLP loci to infer patterns of differentiation and gene flow in populations of the widespread grassland species *Geranium pratense* at a regional scale. In particular we ask (1) whether the mating system contributes significantly to gene flow; (2) how within and among population genetic diversity is spatially structured and (3) whether potential differentiation patterns are shaped by selectively divergent processes. We found that despite of an outcrossing mating system, gene flow within and among populations is quite limited. Drift is already predominant at scales larger than 10km. Within populations, we found a strong spatial genetic structure partly shaped by historic migration or colonization patterns. We argue that frequent mowing before seed dispersal hinders effective gene flow. Whether also adaptive processes add to the observed differentiation pattern, remains to be tested. Still, our results support the use of local provenances in *G. pratense*.



**Forget the patch! The response of birds and bats to environmental gradients in a variegated landscape**

*Jan Hanspach*<sup>1</sup>, Joern Fischer<sup>2</sup>

<sup>1</sup> *Department of Community Ecology, Helholtz-Centre for Environmental Research UFZ*

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Human-modified landscapes have often been conceptualized as mosaics of different types of habitat patches. Although alternative concepts based on ecological gradients or habitat variegation exist, gradient-based concepts rarely underpin the design of landscape-scale studies. We examined the influence of three anthropogenic gradients on the distribution patterns of birds and bats, namely tree cover, nutrient enrichment and livestock grazing pressure. Our study was conducted in the Upper Lachlan Catchment of New South Wales, a typical grazing landscape of southeastern Australia. We found that tree density had a dominant effect on the species composition and distribution of both birds and bats. Our results underline the ecological validity of the concept of habitat variegation.



POSTER PRESENTATIONS:**Correlation between wing melanisation of European butterflies and mean insolation over the distributional range of species***Stefan Brunzel*<sup>1</sup>, Roland Brandl<sup>1</sup><sup>1</sup> Faculty of Biology, Department of Animal Ecology, Philipps-Universität Marburg

Ecogeographic rules like Bergmann's rule became attractive for research because of the connection between physiological processes and distributional patterns of species. These rules apply mainly for endotherms but the findings for ectotherm invertebrates show often contradicting patterns. Many macroecological studies on butterflies attempt to predict distribution and diversity patterns. However, the pattern of butterfly distribution over Europe lacks a comprehensive and consistent explanation which correlates species characteristics with environmental factors. In butterflies, behaviour, habitat selection and reproductive success depend on thermoregulation. An important aspect for thermoregulation of butterflies is the wing colour. In general, darker animals absorb radiation and have therefore certain advantages during thermoregulation. Here, we predict that the mean insolation in the distributional range of species should show a negative correlation to the melanisation of basal wing areas. We found this correlation for the European butterfly distribution with darker species inhabiting higher latitudes with lower insolation, even after adjusting for phylogenetic dependencies. These results were discussed in the light of the thermal melanism hypothesis (THM) for ectotherms and the positive correlation between latitude and paleness in endotherms forming the rule of Gloger.



**Effects of population density and prey availability on body condition of spiders in fragmented landscapes**

*Roman Bucher*<sup>1</sup>, Martin Schmidt-Entling<sup>1</sup>

<sup>1</sup> Institute of Ecology and Evolution, Community Ecology, University of Bern

Landscape fragmentation often affects biodiversity and population densities of arthropods. Thereby, the loss of habitat area usually has a strong negative impact on biodiversity, whereas habitat isolation has variable effects even on related groups of organisms. Landscape fragmentation can affect biodiversity and populations densities via two mechanisms: First, fragmentation can alter the frequency of migration. Second, landscape fragmentation can affect individual fitness. We study the relative importance and possible interactions between these two processes. We used body condition as a measure of fitness. We assume that individuals with a high body mass relative to prosoma width have higher energy reserves to invest in survival and/or in reproduction, with potential consequences population development. The investigation took place on 30 groups of cherry threes that were established in 2008 to vary independently in the amount of woody habitat within 500 m radius and in the isolation from other woody habitats. We hypothesised that (1) body condition is higher in landscapes with a higher amount of suitable habitats, (2) prey availability is higher in landscapes with higher percentage of forest and in patches that are connected to woody habitats, (3) body condition is positively correlated with prey availability, (4) higher population densities of spider reduce body condition do to competition (interference).



## **Theoretical complications in the link between biodiversity and ecosystem productivity**

*Joseph Chipperfield*<sup>1</sup>, Thomas Hovestadt<sup>1</sup>

<sup>1</sup> Field Station Fabrikshleichach, University of Würzburg

There has been much theoretical and empirical work documenting the link between biodiversity and ecosystem productivity. By extending Hubble's models of ecological drift to allow for simple niche structure and spatial dynamics, we investigate how this relationship changes in landscapes of differing levels of heterogeneity. We show how the interaction of species life history parameters and habitat lacunarity can, in some cases, deeply upset what we think we know about the effect of biodiversity on ecosystem productivity.



**Effects of habitat fragmentation and landscape composition on biodiversity and ecosystem services**

Sandra Krause<sup>1</sup>, John Herrmann<sup>1</sup>, Sonja Stutz<sup>1</sup>, Roman Bucher<sup>1</sup>, Yolanda Stocker<sup>1</sup>, Felix Herzog<sup>2</sup>, Martin Schmidt-Entling<sup>1</sup>

<sup>1</sup> Institute of Ecology and Evolution, University of Bern

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The loss and fragmentation of habitats are a major threat to biodiversity. Ecosystem services such as pest control can be negatively influenced by biodiversity loss. Aphids are major pests on a wide range of crops. Several predators and parasitoids are known to reduce aphid densities. Contrarily, aphid tending ants can enhance aphid densities. We tested the effect of habitat isolation and landscape composition on biodiversity and interactions between aphids, predators and ants on cherry trees. We established 30 groups of cherry trees in sites that have three different levels of isolation from woody habitats and varied in the amounts of forest in the surrounding landscape. We followed the colonization of the trees by arthropods for three years. In addition, we experimentally excluded ants (Formicidae) and/or earwigs (Forficulidae) from some of the trees to test their effects on black cherry aphids (Aphidae: *Myzus cerasi*). We hypothesized that (i) cherry aphid densities are enhanced by ants and reduced by earwigs; (ii) arthropod densities are reduced by habitat isolation and/or landscape composition; (iii) predators are more strongly affected by habitat isolation and/or landscape composition than herbivores, leading to reduced pest suppression on fragmented cherry trees; (iv) predators like earwigs that colonize new locations by walking are more strongly affected by isolation and/or landscape composition than arthropods that colonize new places through the air.



**A framework for delineating biogeographical regions based on species distributions***Holger Kreft<sup>1</sup>, Walter Jetz<sup>2</sup>*<sup>1</sup> Georg-August-Universität Göttingen<sup>2</sup> Yale University

Biogeographical regionalizations, such as zoogeographic regions, represent categorizations central to basic and applied questions in ecology, biogeography, and conservation. Traditionally established based on qualitative evidence, the lack of quantitative support has set constraints on their utility. The availability of global species range maps, multivariate techniques, and computational power now enable a quantitative scrutiny. We develop a methodological roadmap for species-level biogeographical regionalizations at global scales and apply it to mammals. We explore the relative usefulness of ordination and clustering methods, and validation techniques. The number of clusters will usually be driven by the purpose of the study, but we present several approaches that provide guidance. Non-metric multidimensional scaling offers a valuable first step in identifying and illustrating biogeographical transition zones. For the clustering of regions, nine hierarchical clustering methods vary greatly in utility with UPGMA clustering performing consistently best. The UPGMA approach allows a tree-like phenetic representation of the relative distances of regions. Quantitative biogeographical regions exhibit both striking similarities and differences to the classic biogeographic divisions. This sort of new, quantitative delineation and relationship assessment will likely offer opportunities for more rigorous inference in ecological and historical biogeography.



**Experimental study of metapopulation dynamics and viability using *Tetrahymena thermophila* microcosms**

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<sup>1</sup> Biodiversity Research Centre, Université catholique de Louvain

Understanding what makes some species at risk of extinction is of prime interest to conservation biology. My research project uses microcosms of *Tetrahymena thermophila*, a unicellular organism, to improve our understanding of how species/population features interplay with landscape configuration and environmental factors in determining viability of metapopulation systems.

The metapopulation concept was applied to conservation biology even if its effective value for practical conservation biology is still strongly debated. Indeed, not all its basic principles have been validated, and many studies were either theoretical or field-based and pattern focussed. Our approach combines (1) being a true experimental approach focussed on processes more than on patterns, (2) the massive advantages of microcosms to control landscape and environment, and replicate experiments, and (3) the use of genetically distinct *T. thermophila* clones displaying different life styles (combinations of life history traits) representing several of the major life history strategies found in a wide range of taxonomic groups.

Metapopulation systems will be constructed as sets of test tubes connected by pipes, representing patches and matrix respectively. I will study the relative importance for metapopulation dynamics and viability of (1) landscape configuration (number and connectivity of patches), local habitat quality (e.g. food quantity and quality), and (3) life style (e.g. growth or dispersal strategy).



## The impact of hedgerow-forest connectivity on small mammals in agricultural landscapes

*Hella Schlinkert*<sup>1</sup>, Christina Fischer<sup>1</sup>, Martin Ludwig<sup>1</sup>, Andrea Holzschuh<sup>2</sup>, Anikó Kovács<sup>3</sup>, Teja Tscharntke<sup>1</sup>, Péter Batáry<sup>1</sup>

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<sup>3</sup> PhD School of Environmental Sciences, Gödöllő, Szent István University, Hungary

Habitat connectivity became an important topic in ecological research, because it counteracts the negative trends of habitat isolation in times of progressing fragmentation in agricultural landscapes. Previous studies showed differences among various species in vulnerability to habitat fragmentation that may be explained by differences in species dispersal abilities and matrix avoidance. In the present study we surveyed small mammal communities by live-trapping in woody structures with increasing isolation from forests (six forest edges, six hedgerows connected to forests and six isolated hedgerows). Results showed differences in vulnerability to habitat isolation between species specialised to forests and generalist species. Abundance of forest specialists in woody structures decreased with increasing isolation from forest. In contrast, we found no impact of isolation from forest on the abundance of generalist species. Our results suggest that connectivity to forests diminishes negative effects of habitat fragmentation on small mammal forest specialists in woody structures. The preservation and recreation of linear woody structures, enhancing structural connectivity between forests, may have high importance in maintaining metapopulations of forest specialist species.



**Species and functional diversity in semi-natural grasslands: When local management and landscape context matter**

*Reto Schmucki*<sup>1</sup>, Josefin Reimark<sup>1</sup>, Sara Cousins<sup>1</sup>

<sup>1</sup> Physical Geography and Quaternary Geology, Stockholm University

Change in land-use pattern is identified as the main cause of the current loss in biodiversity. While the influence of human activities on species distribution is noticeable in most ecosystems, historic grassland management has resulted in habitats with exceptionally high plant diversity. Over the last century, however, the extent of these semi-natural grasslands has declined dramatically as a result of conversion and intensification of land-use and abandonment of traditional practices. In addition to the effects of habitat loss on plant diversity, species assemblage in remnant grasslands are expected experience further decline, as extinction is likely to exceed colonization in isolated habitats. This study focuses on the effect of landscape context on species diversity and functional response in semi-natural grasslands. We sampled 50 grassland communities distributed over 22 islands in the Stockholm archipelagos. Using 25 pairs of adjacent habitats, we modeled the effect of land-use on species diversity in grassland communities. Furthermore, we examined the functional response of species assemblages. While our data provide no clear evidences of extinction debt in remnant grasslands, grazing affect small-scale plant diversity. At the habitat-level, however, variation in species diversity is best explained by today's landscape context, suggesting that other land-use can provide refuges for grassland species and increase connectivity between remnant habitats.



## SESSION 07 - PLANT POPULATION ECOLOGY

CONVENOR: ARNDT HAMPE

ORAL PRESENTATIONS:

### **A comparison of central and peripheral populations of *Carduus defloratus***

Andrea Vaupel<sup>1</sup>, Diethart Matthies<sup>1</sup>

<sup>1</sup> Department of Ecology, University of Marburg

We tested the predictions of the abundant centre model (ACM) by studying 66 populations of *Carduus defloratus* (Asteraceae) from the centre to the margin of its distribution in Central Europe. Peripheral populations from Northern Hesse, Thuringia, and the Franconian and Swabian Albs were smaller and less dense than central populations from the Alps and the Swiss Jura. Plants in peripheral populations were larger but produced less seeds per capitulum and per plant than those in central populations. Reduced reproduction was due to both a lower number of seeds initiated and a higher number of seeds aborted. Together with strong effects of population size on seed production this suggests that reproduction in the small and isolated peripheral populations may be pollen limited resulting in inbreeding and high seed abortion. In contrast, predispersal seed predation by insects was much higher in central than in peripheral populations, suggesting that seed predators may also have difficulties finding the small and isolated peripheral populations. In conclusion, the results of our study support the main predictions of the ACM, but contrary to predictions plants in central populations were smaller, presumably because they were growing at higher altitudes.



**Phenological differences in frost hardiness of different central European tree species**

*Maria Auerswald*<sup>1</sup>, Helge Bruelheide<sup>1</sup>

<sup>1</sup> Martin Luther University Halle-Wittenberg

Frost is one of the most important environmental factors for temperate plant species. Damages resulting from low temperatures often lead to reduced growth or possibly to the death of the whole plant. Many studies have investigated frost hardiness of woody species, but not much is known yet about the species-specific impact of late spring frost events. The aim of this study was to assess the importance of frost at the time of bud burst for various deciduous central European tree species. The approach was to expose closed and opened buds to different levels of frost stress. We hypothesized that late-budding species have a lower frost hardiness at the time of bud burst and with a late bud burst escape the risk of late spring frost damages. Frost hardiness was assessed in a climate test chamber and analysed as electrolyte leakage. The resulting data were tested for differences between early-budding and late-budding species. In contrast to our hypothesis, the frost hardiness of the freshly opened buds did not differ between species, irrespective of the measured frost hardiness before bud break. The opened buds of all investigated species could tolerate temperatures to a minimum  $-8^{\circ}\text{C}$  without becoming damaged. In summary, the differences in time of bud burst of tree species could not be linked to frost hardiness of the buds neither before nor after bud break.



**Why do imports grow higher up New Zealand mountains than native conifers?**

*Ellen Cieraad*<sup>1</sup>, *Margaret Barbour*<sup>2</sup>, *Robert Baxter*<sup>3</sup>, *Matt McGlone*<sup>4</sup>, *Brian Huntley*<sup>3</sup>

<sup>1</sup> Durham University, Landcare Research

<sup>2</sup> University of Sydney

<sup>3</sup> Durham University

<sup>4</sup> Landcare Research

New Zealand native treelines are found at low altitudes compared to other treelines around the world. However, exotic conifers can establish hundreds of metres above the native angiosperm and conifer treelines. Determining the factors that are limiting native species' current distribution is critical when attempting to predict changes in treeline altitude in response to climate warming. Here we focus on a controlled environment study comparing the photosynthetic performance of native and exotic conifers at different temperature regimes. Higher temperatures increased the carbon uptake of all tested saplings. *Pinus* also had higher maximum carboxylation and saturated photosynthetic rates than native conifers at all temperatures tested, while its ratio of light-saturated photosynthetic rate to dark-acclimated respiration rate was 2-fold higher, on average, than in the native conifers. These features explain, at least partly, its superior performance above the native treeline, and suggest that predicted global warming will have a larger positive effect on the net-carbon uptake of *Pinus* than of the native species. Low assimilation rates of native conifers at low temperatures are consistent with long-term field observations of extremely slow growth, especially near treeline. Longer-term controlled environment experiments and field sampling allow us to test the source/sink limitation hypotheses near treeline.



**Assessing the carbon source for fruiting in mature trees one year after long-term  $^{13}\text{C}$ -labelling**

Günter Hoch<sup>1</sup>, Qingmin Han<sup>2</sup>, Rolf Siegwolf<sup>3</sup>, Christian Körner<sup>4</sup>

<sup>1</sup> Institute of Botany, University of Basel

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<sup>4</sup> Institute of Botany, University of Basel, Switzerland

Reproduction is considered a strong sink for carbon (C) in trees. Especially, fruiting in masting species is generally assumed to drain stored C reserves, potentially contributing to the observed oscillating pattern of masting events. Here we assessed the dependency of fruiting on stored C reserves in mature individuals of two masting (*Fagus sylvatica*, *Quercus petraea*) and one non-masting tree species (*Carpinus betulus*) at the Swiss Canopy Crane research facility. Between 2001 and 2008, 14 mature trees were exposed to elevated  $\text{CO}_2$  concentrations. Because the  $\text{CO}_2$  was highly depleted in  $^{13}\text{C}$ , the experiment led to a  $^{13}\text{C}$ -labeling of entire trees, with  $\delta^{13}\text{C}$  of bulk tissue being about 4 ‰ lower than the corresponding tissue of unlabeled control trees. In 2009, the year following the  $\text{CO}_2$  enrichment, the  $^{13}\text{C}$  isotopic label of stored C reserves thus differed significantly from current photoassimilates. In order to identify the C sources for reproduction, we therefore tracked  $^{13}\text{C}$ -labels in different branch tissues, including fruits, throughout the growing season 2009.  $\delta^{13}\text{C}$  of flowers were 4 ‰ lower than in control trees, indicating the usage of stored C for their development. In contrast,  $^{13}\text{C}$ -labels were completely absent in developing and ripe fruits in all three investigated species. This striking result is the first experimental proof that even in masting trees, fruit development does not depend on C reserves, but is exclusively supplied with C from current-year photosynthesis.



**Are epiphytic tank bromeliads nitrogen or phosphorus limited?**

Gerhard Zotz<sup>1</sup>, Uwe Winkler<sup>1</sup>, Wolfgang Wanek<sup>2</sup>

<sup>1</sup> Functional Ecology, University Oldenburg

<sup>2</sup> Chemical Ecology and Ecosystem Research, University of Vienna

In spite of their economic and ecological importance, there is a lack of basic information on the mineral nutrition of bromeliads under natural conditions. This statement refers both to the details of the uptake via absorbing leaf scales as to the identity of the most limiting nutrient element in situ. Using fertilizer experiments together with stable and radioactive isotopes we investigated the uptake of N, P, and K and their effects on growth in a number of bromeliad species. Kinetics experiments show that absorbing leaf scales take up nutrients as efficiently as roots of soil-rooted plants, the biphasic uptake kinetics of P and K being an additional similarity. A substantial proportion of P uptake is not used for current growth, but stored as phytin. In an experiment with a full-factorial design, both N and P supply had a significant effect on relative growth rates (RGR), but only tissue P concentrations were correlated with growth. Increased nutrient supply led to an up to sevenfold increase in tissue P concentration compared to natural conditions, while concentrations of N hardly changed or decreased. This suggests the conclusion that P rather than N is limiting growth in situ, which is also backed up by the analysis of N fractionation. Plants that receive high nutrient supply for almost one year showed a substantial decline in fractionation, while  $\delta^{15}\text{N}$  of plants with low nutrient supply resembled natural conditions.



**Functional diversity of beech ectomycorrhizas for nitrogen uptake***Rodica Pena*<sup>1</sup>, *Andrea Polle*<sup>1</sup><sup>1</sup> Department of Forest Botany and Tree Physiology, University of Göttingen

Beech (*Fagus sylvatica*) roots are colonized by ectomycorrhizal fungi (EMF) that form the soil–tree interface and play a key role in nutrient uptake. EMF communities are very diverse. For example, roots of mature beech trees host about 90 different EMF species (Pena et al. 2010). The factors affecting EMF community composition are still not well understood. Rare EMF species were highly sensitive to the depletion of recent photosynthate (Pena et al. 2010). In addition to carbon availability, EMF community composition may be affected by differences in dispersal, ecological niche differentiation, resource partitioning or functional differences between fungal species. Here we tested the hypothesis that functional differences exist between EMF species with respect to inorganic N uptake from the soil. To test this hypothesis six months old beech seedlings, whose roots systems were colonized by typical EMF communities, were grown under two different light and water regimes and labelled with <sup>15</sup>N to follow N uptake. <sup>15</sup>N and N contents were determined in shoots, roots and root tips of the seedlings. Effectiveness in nitrogen uptake and transport of root tips colonized by EMF in comparison with non-mycorrhizal root tips were studied. <sup>15</sup>N allocation to different EMF species was determined and the contributions of different EMF to N allocation were assessed. We are grateful to German Research Foundation (DFG) for financial support.



**Nitrogen enrichment limits seedling recruitment of a widespread tree species in farmland hedgerows**

Matthias Schleuning<sup>1</sup>, Christoph Böhm<sup>2</sup>, Katrin Böhning-Gaese<sup>1</sup>

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<sup>2</sup> Department of Ecology, University of Mainz

Many plant species occupy different habitats of the patchy cultural landscapes of central Europe, but we hardly know how the underlying spatial variation in environmental conditions translates into differences in population dynamics. Here, we present a study of seedling recruitment of the widespread tree species *Prunus avium* that occurs both in continuous forests and in farmland hedgerows in central Germany. We tested whether seedling establishment and survival differed between five forest and five farmland sites and analyzed whether environmental variables such as adult tree density, light availability, and soil nutrient content accounted for the differences between habitats. We found thrice as many seedlings of *P. avium* in forest than in farmland habitats, while the soil nitrogen content was higher in farmland than in forest habitats. Both the number of established seedlings and seedling survival decreased with soil nitrogen content. Moreover, leaf damage of seedlings was higher in the more densely populated farmland than in the forest populations. Consistent with the Janzen-Connell hypothesis, leaf damage increased with the density of adult trees. We conclude that the combined effects of abiotic and biotic drivers determine the regeneration potential of tree populations in cultural landscapes. In the case of *P. avium*, seedling recruitment is mainly limited by nitrogen inputs from adjacent fields, indicating that farmland populations are not viable in the long term.



## Evolution and dispersal of an herbicide resistant weed

Janin Rummland<sup>1</sup>, Dirk Kerlen<sup>2</sup>, Henning Nordmeyer<sup>3</sup>, Otto Richter<sup>1</sup>

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<sup>3</sup> Julius Kühn-Institut, Federal Research Centre for Cultivated Plants, Institute for Plant Protection in Field Crops and Grassland, Germany

Herbicide resistances in weeds are an increasing problem in agroecosystems. The studied weed species *Apera spica-venti* (L.) P. Beauv. is widely spread in winter cereals in Central Europe.

To investigate the dispersal and the evolutionally process of resistance under varying herbicide strategies a field trial was designed involving four different management strategies on two fields. The density of *Apera spica-venti* was determined before and after the herbicide treatment at fixed grid points. For the identification of the genotypes plant samples were taken to analyze them for SNPs (Single Nucleotide Polymorphism) on the ALS-gene using pyrosequencing. Some of the plants were analyzed by Sanger sequencing. The results were used to evaluate a model for the support of developing management strategies to prevent, reduce or at least decelerating the development of resistance. The model simulates the dynamics of resistance in a weed population based on a combination of a population dynamic and a genetical model which is embedded into a cellular automaton. The model is thus capable of simulating the dispersal of genetic information at field scale in dependence of management measures, such as alternating herbicide treatment, soil cultivation and crop rotation.



POSTER PRESENTATIONS:**Leaf and flower asymmetry in *Saxifraga rosacea* subsp. *sponhemica*: Relationship with population size, genetic variation and fitness**

Melanie Bodenseh<sup>1</sup>, Tania Walisch<sup>2</sup>, Sylvie Hermant<sup>2</sup>, Guy Colling<sup>2</sup>, Diethart Matthies<sup>1</sup>

<sup>1</sup> University of Marburg

<sup>2</sup> Musée national d'histoire naturelle, Luxembourg

Fluctuating asymmetry (FA) of morphological structures is thought to increase with genetic stress due to inbreeding or with environmental stress during the development of an organism and thus has been suggested to be a useful tool for detecting such stresses. We investigated the asymmetry of leaves and flowers of offspring from 24 populations of *Saxifraga rosacea* subsp. *sponhemica*, a rare and naturally fragmented species of rocks. Populations from Belgium, Luxemburg, Germany, France and Czechia were investigated. Significant FA was found for all traits studied. Regions, populations and families differed in the magnitude of FA, with most of the variation existing among families. Levels of FA decreased with the genetic variation of populations, but were not related to population size. FA tended to correlate negatively with some fitness traits such as number of flowers and plant size. The results suggest that in *S. rosacea* levels of FA are related to inbreeding and possibly to conditions during seed formation.



**The Italian populations of *Viola pumila* Chaix – Their ecological and genetic characterization for an integrated conservation strategy**

Fabrizio Buldrini<sup>1</sup>, Daniele Dallai<sup>1</sup>, Lucia Conte<sup>2</sup>, Carlo Del Prete<sup>1</sup>, Carlo Ferrari<sup>2</sup>

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<sup>2</sup> Department of Experimental Evolutionary Biology, University of Bologna

*Viola pumila* Chaix is an Eurasian species linked to large alluvial grasslands. Ecology and conservation problems of its Central European populations have been studied by Hölzel (2003), Eckstein & al. (2004, 2006, 2009) and Danihelka et al. (2009). In Italy, it grows only in 4 Po valley sites, in grasslands and fresh meadows regularly mown, along ditches and cultivated fields. These populations are peripheral with respect to the European distribution of the species. They contain a very low number of individuals in each site (max. 46) and are very distant and strictly isolated from the nearest populations of Central Europe. According to IUCN (2001), this species is critically endangered in Italy (Buldrini & Dallai, in press). Since the best conservation strategy for endangered species implies a detailed knowledge of habitat requirements as well as of its genetic diversity, an ecological characterization of the 4 sites is in progress, by Ellenberg's Indexes modified by Pignatti & al. (2005). Moreover, the genetic diversity of the Italian populations of the species will be evaluated through ISSR markers: semi-arbitrary anchored primers designed from tandem repeat motifs of microsatellites will be used to estimate the level and the distribution of genetic diversity and to provide suggestions for effective conservation programs. A comparison between Italian populations and Central European ones will be performed in the next stage of the research.



## Patterns of pollen dispersal in cultivated and natural populations of cacao – First approaches

Claudia Chumacero de Schawe<sup>1</sup>

<sup>1</sup> Agroecology, Göttingen University

Natural populations of *Theobroma cacao* distribute mainly in patches in continuous forest, along rivers borders and in forest islands in the lowlands of the tropics. This spatial distribution has consequences for gene flow especially for the intertree pollinator movement. In view of ongoing forest fragmentation, knowledge on gene flow is elementary for comprehending the reproductive success in tropical tree species. Pollen dispersal of *T. cacao* was studied in 4 cultivars and in 2 natural populations using genetic markers. 94 offspring of known mother, and 88 candidate fathers were typed at ten microsatellite loci, previously established by Lanaud *et al.* (1999) and Saunders *et al.* (2004). Based in multilocus genotypes a paternity analysis was assessed by simple exclusion using Cervus 3.0. The paternity assignments were statistically significant. Fathers (pollen donors) of 12% of the offspring within a strict level (95%) were identified. Considering a relaxed level (80%), 46% of the pollen donors were identified. Later, the movement of successful pollen was traced by examining the locations of maternal and identified parental trees. Through this, the pattern of pollen dispersal was estimated by determining the distance between mother and pollen donor for each seed sired by trees within and outside the study plots. Despite the minute size (1-2mm) of its pollinators (mainly Ceratopogonidae midges), our first approaches evidenced a pollen migration distance in a range of 8 to 1700m.



**Regional population biology analysis of *Dianthus carthusianorum***

Virginia Duwe<sup>1</sup>, Birgit Gemeinholzer<sup>2</sup>, Daniel Lauterbach<sup>2</sup>, Okka Tschöpe<sup>1</sup>, Michael Burkart<sup>1</sup>

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In Germany, *Dianthus carthusianorum* is an endangered species of dry grasslands with fragmented distribution patterns and a decline in individual numbers. To analyze the species decline, we investigated the genetic structure and plant fitness of populations in Brandenburg and set up a common garden experiment to examine the effects of drought stress on plant fitness. 16 selected populations of different sizes with 12 individuals per population were analyzed using AFLP technique. 3 applied primer combinations provided 164 polymorphic bands. High  $F_{st}$  value (0.32) indicated a clear genetic differentiation between populations, however, with also high within population diversities. The strong genetic differentiation and population structure was also supported by neighbour-joining analysis. A positive correlation also existed between population size and genetic diversity. In addition there was a positive correlation between geographical and genetic distances among populations. In a common garden experiment, significant fitness differences between the 16 analyzed populations could be detected. Drought stress effected plant fitness significantly only in some of them. However, there was no correlation between population size and fitness. In addition higher genetic diversities did not result in an enhanced fitness. The data implied the current population declines are probably the result of environmental factors by habitat fragmentation and isolation rather than missing genetic diversity.



**Nucleotide variation in drought stress response genes at a geographic scale in *Abies alba* Mill.**

Natascha Hasenkamp<sup>1</sup>, Katharina Fettweis<sup>1</sup>, Christina Mengel<sup>1</sup>, Birgit Ziegenhagen<sup>1</sup>, Sascha Liepelt<sup>1</sup>

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The conifer species *Abies alba* Mill. is one of the ecologically and economically most important forest trees in Europe. It is known to be susceptible to changes in climate and summer droughts and, thus, will most likely to be affected by climate change. Therefore, it is crucial to gain knowledge of the selective effects of climatic factors and the genetic basis of drought stress tolerance. In this study, we re-sequenced two candidate genes for drought stress response in silver fir that have recently been identified from expression studies in *Pinus pinaster* Ait. and *Pinus taeda* L. We analyzed nucleotide variation in these two genes in 200 individuals from natural populations of 10 geographically and climatically distinct regions in Europe, supposed to originate from the same glacial refugium, with 10 to 30 individuals per region. In order to distinguish selection induced patterns from demographic processes, e.g. genetic drift, we also analyzed the populations at selectively neutral marker loci. We used different coalescent-based methods to detect outliers from neutral expectations to identify signatures of selection. Preliminary results show that there is nucleotide variation in both genes. Once there is evidence for the studied genes being under selection further investigations will attempt to assess the adaptive potential of silver fir populations and assist in future management decisions.



## Phenology of flowering and seed dispersal: Timing and patterns

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Although the timing of seed maturity plays an important role for seed dispersal in plants until now only little attention has been given to this issue. As the time of flowering is relevant for many ecological plant-plant and plant-animal interactions and most plant flowers are much more conspicuous than their seeds, many studies concerning phenology are focusing the time of flowering. Therefore the following questions emerge: Which general patterns regarding the timing of flowering, seed maturity and seed dispersal can be observed? Do these phases relate to each other across different groups of plant species? To provide first insights a selected set 100 Central European species was studied in a detailed phenological monitoring. Measurements of the developmental phases of flowers, seeds and fruits were studied biweekly for a period of seven months. The timing of flowering, seed maturity and dispersal will be analyzed regarding different functional groups.



**The reproduction niche of *Armeria maritima* ssp. *elongata*, a character species of semiarid grassland on acidic sandy soils**

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<sup>1</sup> Lehrstuhl Vegetationsökologie und Naturschutz, Uni Potsdam

*Armeria maritima* ssp. *elongata* is a character species of semiarid grassland on pleistocenic acidic sandy soils, the phytosociological syntaxon *Diantho deltoideis-Armerietum elongatae*. In contrast to the xeromorphic grass *Festuca brevipila*, the matrix species of this community, leaf traits (SLA and dry to fresh mass ratio) of *Armeria* ranges between xeromorphic and typical mesomorphic species from damp meadows. So the *Armeria* seedlings survive bad within its typical habitat. To analyze the colonization of new suitable habitats 48 ha of a floodplain area of the River Havel, characterized by a mosaic dry sandy hillocks and wet depressions, was mapped in combination with a permanent observation of 184 individuals and a mapping of the spatial micro-distribution of *Armeria* and *Festuca* plants. It has been found that *Armeria* does not colonize its own community on the hillocks directly but it disperses along the habitat edges, the transition zone between semiarid *Festuca brevipila* grassland and alternating wet meadows. Obviously, the seedlings meet here more suitable conditions to survive during dry weather periods. The fine-mapping of the *Diantho-Armerietum* (20 m<sup>2</sup>) revealed a significant spatial affinity of *Armeria* to *Festuca*, indicating protection of *Armeria* seedlings against dry stress in the shade of grass tussocks (facilitation). During further growth both species penetrate each other in which *Armeria* successfully withstands the competition of the grass.



**Microsite and seed limitation of recruitment in a deciduous forest herb**

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Seedlings are an important, but vulnerable stage in the life cycle of plants. The identification of factors affecting their recruitment is therefore fundamental for understanding basic plant population processes as well as plant distribution and abundance patterns. In this study, we used a combined experimental and observational approach to examine how microsite quality and quantity as well as seed supply affect seedling establishment of the perennial forest herb *Phyteuma spicatum* (Campanulaceae). The number of seedlings depended both on environmental conditions and seed abundance, suggesting microsite and seed limitation of recruitment. Seedlings were frequent in microsites with bare soil and overall high light intensities, and were less common in sites with deep litter layers as well as dense and low vegetation. Seed addition, via experimental sowings or via the natural seed rain, consistently enhanced seedling emergence. In one of two seed cohorts, seedling emergence rates, however, decreased at high seed densities. Differences in recruitment due to differences in the frequency of microhabitat types and in the availability of seeds may thus influence local population dynamics and the spatial distribution of individuals within extant populations of the species.



### Three-dimensional morphology of plant infructescenes

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The spatial arrangement of flowers, fruits and seeds may have important implications for pollination and dispersal ecology. However, yet only few approaches have been made to quantify the generative architecture.

Here we used a 3D-digitizer (Microscribe G2X, flexiCAD) to measure the 3D coordinates of seeds and fruits of 13 Central European herb species. Based on these measurements, we calculated the Euclidean distances between the generative objects to describe their spatial arrangement and clustering. The smallest convex hull-polygons around the whole infructescence was calculated to quantify its size and shape. Furthermore, we developed a shape-index that quantifies the deviation of the infructescence from a sphere as the ratio between volume and area of its hull-polygon normalized by the respective value for a sphere with identical volume.

We found a relationship between the distribution of the Euclidean distances of the seeds and the shape of the infructescence. Infructescences with unimodal distributed distances often had a shape close to that of a sphere, whereas infructescences with skewed or bimodal distributed distances were usually deviating from a sphere. The new method was precise and easily applicable to plant species with infructescences smaller than approximately 50 cm.

We conclude that presented indices used to quantify plant architecture can help to gain a better understanding how the spatial arrangement of generative structures is related to pollination or dispersal ecology.



**High clonality in a natural regenerated stand of poplars along a river stretch?**

Iris Landschulze<sup>1</sup>, Silke Knoche<sup>1</sup>, Birgit Ziegenhagen<sup>1</sup>, Ronald Bialozyt<sup>1</sup>

<sup>1</sup> University of Marburg

European black poplar (*Populus nigra* L.) is a pioneer species of riparian softwood forests. Due to human influences on river regulation, urbanization and agricultural use of flood plains it is a serious threatened species in Europe. Remaining natural stands are considered to act as source populations for restoration purposes. In this study we investigated the importance of generative and vegetative reproduction for natural regeneration of poplars along the Rhine River. Therefore a natural regenerated young stand of poplars along a river stretch was analysed for genetic diversity using seven microsatellite markers. Adult trees analysed in a former study revealed several hybrids of *P. nigra* and *P. deltoides* (*P. x canadensis* hybrids) in the stand. Thus four marker contain diagnostic alleles for *P. deltoides*. In addition, the chloroplast DNA marker DT was used to identify the maternal origin. Offspring of several years determined by BHD ranging from 1-68 cm were sampled. Parentage analysis of the offspring was used to quantify pollen- and seed-mediated gene flow. Thereby cultivated *P. x canadensis* trees in the vicinity could act as potential parents. First results indicate an increased proportion of clones in the juveniles. 6 percent of the 209 juveniles were found to exhibit at least one *P. deltoides* diagnostic allele, so far.



**Genetic diversity of *C. lanatus* var. *lanatus* oleaginous at the scale of a village**

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*Citrullus lanatus* var. *lanatus* (watermelon oleaginous type, also called egusi watermelon) is a minor crop cultivated in sub-Saharan Africa for its seeds rich in nutrients (~ 60% lipids and ~30% proteins). Unfortunately, for many years a decline of the culture in Ivory Coast has been observed; watermelon oleaginous type could well be threatened with extinction or genetic depletion. To preserve the genetic diversity of watermelon oleaginous type, the current genetic diversity and the factors that control its evolution must be understood. To this end, the structure and genetic diversity of oilseed watermelon were analyzed in two villages, a total of 276 plants (23 plants in 12 fields) were genotyped using nine microsatellite markers. The F-statistics of Wright were calculated: a lack of heterozygosity within the fields has been demonstrated, and the absence of structure ( $F_{ST} = 0.037$  overall). This lack of structure was also supported by a principal coordinate analysis and the method of assignment. However, the  $F_{ST}$  pairwise showed that specific fields were well separated from others, independently of their village of proceeding. These results provide information on the genetic diversity of watermelon oleaginous type that can help to adopt conservation strategies for the establishment of a seed bank.



**Is the high floristic diversity of Central European and Dinaric meadow communities accompanied by divergence in functional traits?**

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We tested whether flora from both meadows are taxonomically and functionally distinct from each other. We then examined whether functional trait differences between sites increase proportionally with increasing floristic differences. Finally, we compared alpha and beta diversity components for Rao's quadratic entropy, species richness and Simpson diversity. Ultimately, we aimed to test if the high observed local and regional floristic diversity of these meadows is reflected in correspondingly high values of functional diversity. The results from PerMANOVA indicate that, although the regions are distinct floristically, there is no strong evidence for functional distinctiveness in meadow communities between regions. Whether the meadows in each region were taken separately or together, the increase in pairwise Euclidean distances in functional space was much lower than would have been expected under a directly proportional relationship with floristic distance. Diversity partitioning revealed that the alpha component contributed the vast majority of regional diversity for Rao, while the opposite was true for Simpson. Alpha diversity for both Simpson and Rao indices was strongly significantly lower than expected at random; in contrast, results for beta diversity for both Simpson and Rao were significantly greater than would have been expected at random, a finding that supports the existence of environmental filters that create a convergence of traits between coexisting species.



**Is population structure indicating ongoing gene flow among two parapatric *Abies* species?**

Lea Schenkelberg<sup>1</sup>, Andreas D. Drouzas<sup>2</sup>, Birgit Ziegenhagen<sup>1</sup>, Sascha Liepelt<sup>1</sup>

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Plant and animal populations will face great challenges in the future due to a multitude of environmental changes. To predict the impact of these changes and for scientific decisions about conservation issues, we need to understand ecological and evolutionary processes like hybridisation and speciation. *Abies alba* Mill. and *A. cephalonica* Loud. are important forest trees in the Mediterranean region and Central Europe. They are considered parapatric species and artificial crossing experiments suggest that there are weak reproductive barriers among Mediterranean *Abies* species. Where the distribution ranges of *A. alba* and *A. cephalonica* meet, a third taxon has been identified and named *A. borisii-regis* Mattf.. Opposing theories exist about its origin. Most authors propose that it is of hybrid nature and name *A. alba* and *A. cephalonica* as parent species. In this case, the question would be whether hybridisation is still going on. Another proposed possibility is that *A. borisii-regis* is the progenitor of *A. alba* and *A. cephalonica*. We used nuclear microsatellite markers to study population structure in a south-north transect throughout the range of *A. cephalonica* and the southeastern part of the range of *A. alba* including populations of *A. borisii-regis*. The aim of the study is to better understand the relationships of the three taxa and to identify possible hybridisation or introgression as well as the extent of potential hybrid zones with the help of Bayesian cluster analysis.



**Population fitness of habitat specialist grass in declining habitats**

Krista Takkis<sup>1</sup>, Aveliina Helm<sup>1</sup>, Liina Saar<sup>1</sup>, Meelis Pärtel<sup>1</sup>

<sup>1</sup> Department of Botany, University of Tartu

During the last century, area of the semi-natural communities in Europe has drastically declined, resulting in fragmentation and deterioration of habitats. This has led to the local extinction of several plant species, though the final amount of disappearing species can currently still be hidden by the extinction debt. However, changes in population structure, genetic diversity and realized plant traits might be detectable prior to loss of species and hence describe the actual status of populations in fragmented habitats. By using habitat specialist grass *Briza media*, we explored the correlation between genetic diversity and realized plant traits in 21 calcareous grasslands in Estonia. In addition, we studied how the fitness-related traits (population density, number and variability of spikelets) are related to historic (1920s and 1930s) and current landscape parameters (area and connectivity of habitats and human population density near habitats).

Our results indicate that *B. media* population fitness can be described using both genetic and phenotypic traits, which are also interrelated with one another. Furthermore, the condition of populations was related to both historic and current landscape structure, showing the importance of historically developed population structure on the one side, and the effect of recent landscape changes on the other. This indicates that *B. media* populations, being influenced by the changing landscape patterns, are shifting towards a new equilibrium in their condition.



**Can phenotypic plasticity be an initial prerequisite for invasiveness in *Brachypodium sylvaticum*?**Kathleen Flade<sup>1</sup>, Ewald Weber<sup>2</sup>, Anton Fischer<sup>1</sup>, Markus K. Zaplata<sup>1</sup><sup>1</sup> Department for Ecology and Ecosystem Management, Technische Universität München<sup>2</sup> Chair of Biodiversity research / Special Botany, Universität Potsdam

*Brachypodium sylvaticum*, a grass and character species of the class Querco-Fagetea is becoming already frequent during the early primary succession occurring in the artificial catchment Chicken Creek in Brandenburg, Germany. The site was established in 2005 and is a six ha large study object of the Transregional Collaborative Research Centre “Structures and processes of the initial ecosystem development phase in an artificial water catchment”. In Chicken Creek the grass faces environmental conditions (sunny open vegetation) that are different from the ones in the presumed source areas (shady forest interior). Individuals from Chicken Creek possess significantly increased fitness compared to plants of the nearby forest (number of inflorescences and mean seed number:  $p < 0.0001$ ). From both origins we collected seeds and now carry out a germination experiment. A “reciprocal transplant experiment” with the three factors: origin (forest as native range vs. Chicken Creek catchment as “invasive” range), substrate (of the native vs. “invasive” range), and lighting (shaded like in the native vs. full sun like in the “invasive” range) will follow. Thus our study aims to examine the extent of phenotypic plasticity within the context of initial prerequisites of biologic invasions.



**Chlorophyll fluorescence of three Chilean *Nothofagus* (Fagaceae) species – Can we relate photosynthetic performance to ecological behavior?**

Maik Veste<sup>1</sup>, Carlos Ramirez<sup>2</sup>

<sup>1</sup> Bioenergy and Agroforestry Research, Hamburg

<sup>2</sup> Instituto de Botánica, Universidad Austral de Chile, Valdivia, Chile

Evergreen and deciduous *Nothofagus* species are the most important trees of the temperate forest in Chile and Argentina. The photosynthetic performance of deciduous *Nothofagus* species (*N. antarctica*, *N. alpina*, *N. obliqua*) were investigated under similar environmental conditions in a common garden experiment. Chlorophyll fluorescence measurements were carried with a PAM 2100 portable photosynthesis system. The highest electron transport rates of sun-exposed leaves were found in *N. antarctica* with 135.7 – 187.4  $\mu\text{mol m}^{-2} \text{s}^{-1}$ , while in *N. alpina* 73.2 – 81.3  $\mu\text{mol m}^{-2} \text{s}^{-1}$  and *N. obliqua* 86.2 – 103.7  $\mu\text{mol m}^{-2} \text{s}^{-1}$ . While maximum quantum yields of the photosystem II (Fv/Fm) showed only small variations among the species. The measured values varied between 0.75 up to 0.78. The photosynthetic performance of the three investigated species correspond with their ecological behavior and with their habitat conditions: *N. alpina* and *N. obliqua* are shade tolerant species that growing in depth and good drainage soils, while *N. antarctica* prefers extreme habitats in open areas with stony or organic soil and with cold, flooding or dry conditions.



**Contrasting effect of plant diversity on plant biomass**

*Nadine Sandau*<sup>1</sup>, Louis-Felix Bersier<sup>1</sup>, Yvonne Fabian<sup>1</sup>, Odile Bruggisser<sup>1</sup>

<sup>1</sup> Ecology and Evolution, University of Fribourg

The effect of diversity on ecosystem functioning has mainly been investigated by the diversity-productivity relationship. Studies concentrating on the producer level show that more diverse communities are more productive in terms of biomass. We used 12 sown wildflower strips in an agricultural landscape, each consisting of 12 plots, with different sown plant diversities (2, 6, 12, 20 species) and manipulation of key herbivores (slugs) to explore plant diversity effects on various trophic levels. Here, we provide results on plants. Contrary to other studies, plots were not weeded. By excluding herbivores, plant biomass and plant species richness increased. Sown plant species richness was negatively correlated to the number of external invaders (i.e., plants not belonging to the sown mixture). Plant biomass was positively correlated to the number of sown species but, interestingly, was negatively correlated to actual plant richness. This apparently contradictory result can be explained by two reasons: firstly, sown species belonged to a single functional group ("tall herbs"), and competition might have been more intense than facilitation in these mixtures; secondly, invading species were mostly part of the "small herbs" functional group. While they strongly contributed to actual species richness, their proportional contribution to overall biomass remained small.



## SESSION 08 - PLANT INVASION

CONVENOR: LUTZ ECKSTEIN, ANTON FISCHER

ORAL PRESENTATIONS:

### **Mechanistic understanding of a rapid and variable plant invasion**

Frank Schurr<sup>1</sup>, Anna Kuparinen<sup>2</sup>, Jürgen Groeneveld<sup>3</sup>, Susanne Lachmuth<sup>1</sup>

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<sup>3</sup> Department of Ecological Modelling, UFZ Helmholtz Centre for Environmental Research, Leipzig, Germany

Understanding and predicting the spread of plant species is a key task for ecology. In particular, spread predictions are needed to assess and efficiently manage the ecological and economic risks posed by alien invasive plant species. So far, however, attempts to mechanistically predict spread rates of invasive plants have been frustrated by limited knowledge about the frequency, magnitude and causes of rare long-distance seed dispersal which drives plant spread. Here we examine whether the historical spread of one of Europe's fastest plant invaders (the South African Ragwort, *Senecio inaequidens*) can be explained by mechanistic predictions of how continental-scale spread arises from plant reproduction and wind-driven seed dispersal. To reconstruct historical spread rates we combine a molecular phylogeography with floristic records, and to derive mechanistic predictions of invasive spread we combine data and models from atmospheric physics and population ecology. Finally, we discuss implications of this mechanistic analysis for the potential to control invasions and for our ability to predict the continental-scale spread of plant species from the reproduction and dispersal of individuals.



**Pinpointing the spread of the giant hogweed in changing landscapes**

Sylvia Moenickes<sup>1</sup>, Jan Thiele<sup>2</sup>, Marlene Gelleszun<sup>2</sup>, Mona Richter<sup>2</sup>

<sup>1</sup> Institut für Geoökologie, TU Braunschweig

<sup>2</sup> Institut für Landschaftsökologie, Universität Münster

The Causasian giant hogweed *Heracleum mantegazzianum* is not only a successful invasive species causing typical problems to biodiversity and agro-economics, but also a health hazard. Its main competitive advantages were found to be early germination, fast growth, early flowering, high fecundity, and low mortality (Pyšek et al. 2007). Both, matrix based models and spatially explicit individual based models contributed to unveil important strategies (Hüls et al. 2007; Nehrbass and Winkler 2007), e.g. exemplarily determining the role of long-distance dispersal. Here, we make use of a comprehensive field survey to additionally discriminate between local dispersal, dispersal along vectors and scattered dispersal. The field survey comprises 20 German study areas of 1 km<sup>2</sup> where *H. mantegazzianum* stands were mapped with differential GPS in 2002 and 2009 and for which realistic landscape configurations of habitats were extracted from aerial images. The model applied consists of a matrix population model implemented in a cellular automaton with four types of dispersal and landscape dynamics taking succession and anthropogenic disturbance into account. Need for management action can thus be defined more accurately.

**Hüls J., Otte A. and Eckstein R.L. (2007):** Biological Invasions 9: 799-811.

**Nehrbass N. and Winkler E. (2007):** Ecological Modelling 201: 377-384.

**Pyšek P., Cock M.J.W., Nentwig W. and Ravn H.P. (2007):** Ecology and Management of Giant Hogweed. CAB International.



**Colonization potential of the opportunistic herb *Conyza canadensis* at the landscape scale in an initial catchment**

Markus Zaplata<sup>1</sup>, Susanne Winter<sup>1</sup>, Detlef Biemelt<sup>2</sup>, Anton Fischer<sup>1</sup>

<sup>1</sup> Department for Ecology and Ecosystem Management, Technische Universität München

<sup>2</sup> Hydrology and Water Resources Management, Brandenburg University of Technology

Sink and source are fundamental terms in population dynamics; however, their dynamics have never been investigated with regard to the colonization velocity at a large scale. At the artificial catchment “Chicken Creek” (6 ha, Brandenburg, Germany) that was constructed with quaternary material, we quantitatively studied the possible plant entry pathways (i) soil substrate (soil seed bank) and (ii) wind (seed rain) and the developing vegetation. Soil seed bank and vegetation analyses were carried out at a regular 20 m x 20 m grid and seed rain traps were exposed every 20 m along the catchment border. The neophyte Asteraceae *Conyza canadensis* was the dominant spontaneous first colonizer species. It was by far the most frequent species in the initial seed rain. *C. canadensis* individuals, which first occurred in 2006, were distributed evenly in regard to cover degree and autocorrelation analysis. However, the seed traps showed significant differences during the first seed shedding period of catchment plants in autumn 2006: At the eastern catchment border, 6.6 times more *C. canadensis* seeds were caught. A correlation with the prevalent winds indicates that the catchment became a source for *C. canadensis* seeds that quickly. Our study adds quantitative understanding of seed dispersal to conceptions of large-scale dynamics.



**Plant invasion from a scale perspective: The case of *Oxalis pes-caprae* in a Mediterranean island**

Akis Siamantziouras<sup>1</sup>, George Papamichael<sup>1</sup>, Yiannis Matsinos<sup>1</sup>

<sup>1</sup> Biodiversity Conservation Laboratory, University of the Aegean

The widespread process of biological invasion affects a variety of natural systems causing both ecological and economic impacts. The association of plant invasion with the underlying biotic and abiotic factors is still considered to be species-specific and no general conclusions can be drawn. The aim of this study was to explore this association taking into account different spatial scales of operation in order to identify possible spatial constraints. We calculated landscape level metrics for 214 close-paired pixels with FRAGSTATS 3.3 software, using field data of the invasive pseudoannual geophyte *Oxalis pes-caprae* L. (Oxalidaceae) from the island of Lesbos (Aegean Archipelagos, Greece). Each paired pixel consisted of one invaded with *Oxalis* present and one control pixel with *Oxalis* absent. The plant invader is extremely abundant in cultivated areas (especially in herbaceous vegetation understory of olive groves), while appears small natural populations in pine forests. Our results indicate a pronounced scale variability of the association between spatial distribution of the plant invader and the underlying factors. It has been suggested that drawing conclusions for the relationship between a species and its environment, based on observations at a single scale may be mislead in judgments on the importance of habitat factors affecting this relationship. Future monitoring plans should take a scale-oriented approach in order to better account for the observed association.



## First results of the biological control of Japanese knotweed in Europe

René Eschen<sup>1</sup>, Alex Brook<sup>1</sup>, Anna Harris<sup>1</sup>, Richard Shaw<sup>1</sup>

<sup>1</sup> CABI Europe-UK

Japanese knotweed (*Fallopia japonica*) is a notorious invasive species that costs the British economy £150M annually. Biological control could limit these costs and facilitate conventional management. After seven years of research the Japanese knotweed psyllid, *Aphalara itadori*, has been released in England. Here we give an overview of the development and application process for the first insect biological control agent in Europe. We also present the first results of a 5 year monitoring study that is being conducted at release and control sites to record the efficacy of the Japanese knotweed psyllid as a biological control agent and its impact, if any, on the wider environment.



**The role of propagule pressure, genetic diversity and microsite limitation for *Senecio vernalis* invasion**

Lydia Hantsch<sup>1</sup>, Helge Bruelheide<sup>1</sup>, Alexandra Erfmeier<sup>1</sup>

<sup>1</sup> Institute of Biology / Geobotany and Botanical Garden, Martin Luther University Halle Wittenberg

Propagule pressure can be seen as a proxy for genetic diversity, and was shown to be particularly important in the face of microsite limitation. However, only few attempts have been made to disentangle effects of propagule pressure and genetic diversity experimentally. To assess the relative importance of these components for the invasion success of *Senecio vernalis*, we created propagule mixtures of four levels of genotype diversity by combining seeds from large distant populations, close distant populations, single populations and seed families in a nested design. Genotype diversity was crossed with three levels of seed density in a container experiment with *Festuca rupicola* as recipient matrix. In a second experiment, we tested for effects of microsite limitation and genotype diversity by manipulating densities of the *Festuca* matrix. High propagule pressure increased the number of seedlings and mid-term establishment of *Senecio vernalis*. Against expectation, with increasing density of the matrix, the initial establishment of *Senecio vernalis* increased, although subsequent demographic development was negatively affected. In both experiments, we found only few effects of genotype diversity to explain seedling establishment and development, however, AFLP analyses revealed that most genetic variation was found within populations. As a conclusion, high propagule pressure seems to be intimately linked to genetic diversity and as such the key to explain *Senecio vernalis* invasion.



**Influence of different litter types and moisture on germination success of the expanding therophyte *Ceratocarpus claviculata***

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During range expansions a number of ecological traits and environmental filters determine the outcome of colonization events, i.e. successful establishment and persistence of populations. In therophytic plant species above all germination and establishment are crucial events in the plant's life cycle. We studied germination requirements using the expanding, short-lived woodland plant *Ceratocarpus claviculata* (L.) Lidén. The species has been considered as eu-atlantic but spread during the last decades east- and northwards into sub-continental and north-temperate regions. In a field study we found that germination was higher in the native than in the invaded range of the species indicating that climatic and microhabitat conditions such as moisture and temperature might have a major impact on germination success of *C. claviculata*. In a following greenhouse experiment we wanted to identify factors influencing germination success by manipulating watering regime and litter amounts of different litter types found across the range. The results of this study will be discussed with respect to the potential of litter to increase germination success through attenuating effects on climatic extremes such as drought or cold.



**Low impact of tree diversity on herb layer productivity and invasion resistance in experimental communities in subtropical China**

Sabine Both<sup>1</sup>, Helge Bruelheide<sup>1</sup>, Alexandra Erfmeier<sup>1</sup>

<sup>1</sup> Institute of Biology / Geobotany and Botanical Garden, Martin-Luther-University Halle-Wittenberg

Knowledge about diversity - invasibility relationships is mainly based on experiences gained from grassland ecosystems, thus far. However, quantifying the impact of tree layer attributes to herb layer invasibility could provide a broader knowledge about mechanisms of forest invasibility by taking forest community complexity across strata into account. In the context of the first biodiversity and ecosystem functioning experiment in subtropical China (BEF China), we established a common garden experiment to study effects of tree diversity on herb layer productivity and invasibility. On a total number of 178 plots, each 16 trees were planted as combinations of four typical species of subtropical broad leaved forests (*Elaeocarpus decipiens*, *Schima superba*, *Castanea henryi* and *Quercus serrata*) at four levels of diversity (0, 1, 2, 4 species). A full-factorial design was applied with fertilizer and seed addition treatment with mixtures of seeds from eight exotic herb species. Community dynamics were assessed monthly and biomass harvested at all 178 plots after one growing season. Exotic species addition significantly affected native herb layer biomass; however, tree diversity did not affect exotic but native biomass only. Fertilizer application had no effect on native herb layer biomass, whereas biomass of invasive species was significantly increased. The overall importance of tree diversity control was rather low but seems to more important for native than exotic herb species.



POSTER PRESENTATIONS:

**Potential solutions for the control of riparian and aquatic invasive weeds: A review of the progress of classical biological control programmes in the UK**

Richard Shaw<sup>1</sup>, Rob Tanner<sup>1</sup>, Djami Djeddour<sup>1</sup>, Ghislaine Cortat<sup>1</sup>, René Eschen<sup>1</sup>, Corin Pratt<sup>1</sup>

<sup>1</sup> CABI Europe-UK

The impacts of invasive alien species on riparian ecosystems can be profound and include reduced biological diversity, increased potential flood risk, increased bank erosion, reduced access and land devaluation. Most of our worst invaders share one common attribute; they were introduced without the suite of natural enemies which keep the plants in check in their native range. Classical biological control aims to readdress this imbalance through the use of specialist and effective natural enemies. The UK is leading the research into the biological control of several invasive aquatic and riparian plants common to many European countries. This poster highlights the status and potential of ongoing research into the biological control of IAS in the UK in the context of the Water Framework Directive, with particular reference to Himalayan balsam (*Impatiens glandulifera*), floating pennywort (*Hydrocotyle ranunculoides*), giant hogweed (*Heracleum mantegazzianum*), floating fairy fern (*Azolla filiculoides*) and Japanese knotweed (*Fallopia japonica*), where in the case of the latter the UK government has approved the release of the biological control agent *Aphalara itadori*.



**Impacts of invasive *Acacia longifolia* on the vegetation structure and regeneration dynamics in Mediterranean-atlantic open dunes and dune forests**

André Große-Stoltenberg<sup>1</sup>, Katherine G. Rascher<sup>2</sup>, Andreas Vogel<sup>1</sup>, João Augusto Alves Meira-Neto<sup>3</sup>, Cristina Máguas<sup>4</sup>, Christiane Werner<sup>2</sup>

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The Genus *Acacia* contains some of the most invasive species that are able to transform native ecosystem properties (“invasive engineers”) and thus can limit the availability of resources such as light to facilitate its own invasion while negatively affecting the native flora (Cuddington & Hastings 2004). In this study, the main focus was to determine, if the exotic *Acacia longifolia* is an invasive engineer in Mediterranean-atlantic Portuguese dune ecosystems (stabilized dunes and dune forests). In 136 plots at 10m<sup>2</sup>, we recorded abundance, basal area, canopy cover, and light conditions (hemispherical photographs) to analyse the impacts of *A. longifolia* on vegetation structure and rejuvenation. *Acacia longifolia* added a new growth form (micro-meso phanerophyte) to habitats usually consisting of large trees or small shrubs and herbs. It changed the vegetation structure and took control over the resource “light” by building dense thickets and significantly increasing the interception of gap light. Native species abundance and cover declined with increasing canopy cover of *A. longifolia*. *Acacia longifolia* only had a facilitative effect on its reproduction in the forest but it negatively impacted the native species’ regeneration in both habitats. The native species’ reproduction declined the closer they were growing to an adult *A. longifolia* plant. By altering the light conditions, *A. longifolia* showed typical characteristics of an invasive engineer (see Rascher et al. 2010).



## Development and phenology of *Ambrosia artemisiifolia* populations from different European sites

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*Ambrosia artemisiifolia* is currently one of the most crucial alien plant species in Europe. In recent decades this annual has started invading new areas - a process driven by climate change and abolishment of dispersal limitation. Inducing allergies and asthma the species is considered as serious threat for human health. To predict the probability of a further invasion in Europe we have to improve our understanding of the environmental conditions being crucial for the completion of *Ambrosia's* life cycle via building mature seeds. In particular, since the species has been introduced several times, it is important to characterize the diversity of requirements of the different European phenotypes. Therefore, we investigated growth and phenological development of populations from 40 different European sites under standard conditions. Regularly, several life history traits (e.g. dry biomass, time of flowering, seed maturity) were investigated. Accumulated temperature was calculated as growing degree days (GDD = accumulation of mean daily temperature above a base temperature of 5°C). We observed differentiations in the form of growth and the phenological development, e.g. populations from the northern border of *Ambrosia's* current range initiated flowering after 621.2GDD. Other populations needed at least 845.3GDD to achieve this phenological stage. Such differences between individual populations have to be taken into account when predicting *Ambrosia artemisiifolia's* future range shifts.



## Common ragweed and road traffic: Influence of different traffic intensities on seed dispersal distances along roadside verges

Andreas Lemke<sup>1</sup>

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Common Ragweed (*Ambrosia artemisiifolia*) is an invasive plant species introduced from North America to Europe. It probably benefits from human mediated dispersal (HMD), as it spreads rapidly along the transportation network and occurrences are highly related to human activities. Although highly important for the development of sustainable management strategies, the role of traffic related dispersal at these sites is still rarely quantified. Only few studies provide experimental evidence. In this study we analyzed impacts of road traffic on the dispersal of *A. artemisiifolia* along roads. We exposed UV-colour-marked seeds of *Ambrosia* on roads of different traffic intensity and recaptured the longitudinal and lateral seed distribution on the verges. We achieved a high recapture rate at the road verge. Traffic intensity showed an influence on the measured dispersal distances: The highest dispersal distances were recorded along the road with the highest traffic intensity both for  $d_{\text{median}}$  (8.13 m) and  $d_{\text{max}}$  (44.81 m). These transport distances were more than an order of magnitude higher than primary dispersal distances which reached only 0.39 m ( $d_{\text{median}}$ ) and 1.59 m ( $d_{\text{max}}$ ). Hence, HMD via road traffic is an effective dispersal mechanism for common ragweed and provides realistic possibilities for long-distance dispersal.



## **Control of invasive species on protected areas. Comparison of German and Polish experiences**

*Agnieszka Sendek*<sup>1</sup>, Barbara Tokarska-Guzik<sup>2</sup>, Katarzyna Koszela<sup>2</sup>, Izabela Żabińska<sup>2</sup>, Sabina Tarłowska<sup>2</sup>, Stefan Klotz<sup>3</sup>

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Invasive alien species are considered to be one of the main direct drivers on biodiversity loss across the globe. Therefore their presence is undesirable, particularly on valuable and protected sites like national parks or biosphere reserve. On such areas eradication and control treatments are recommended. Presented study is an overview of the knowledge about occurrence and control methods of invasive plant species present in protected areas of Poland and Germany. Obtained information is derived from questionnaires sent to national parks, landscape parks, biosphere reserves and natural parks. Data collected until now originated from twenty-eight sources (eighteen from Germany and ten from Poland). The biggest number of answers comes from National Parks (eight from Germany and ten from Poland). Other data were sent by biosphere reserves, natural parks and local authorities. Further information from other units is still expected. On the basis of obtained results a list of the most inconvenient species present in the protected areas of both Poland and Germany will be prepared. Furthermore some of the most successful control attempts will be described. Our study is a significant contribution to a better knowledge of the occurrence, the impact and efficient control methods.



**Greenhouse experiments reveal: Invasive Salicaceae in Patagonia out-compete the native by vegetative reproduction**

Lena Tölle<sup>1</sup>, Lisa Kleinig, Birgit Ziegenhagen, Ilona Leyer

<sup>1</sup> Philipps-Universität Marburg

In the last decades, invasive willows and poplars (Salicaceae) have built dense floodplain forests along the Rio Negro River in Patagonia, Argentina. One of the striking features of these taxa and their native counterpart *Salix humboldtiana* is their capacity to regenerate by broken twigs dispersed by water. In two greenhouse experiments we tested the hypothesis that cuttings of the three most dominant invasive taxa (two *Salix* hybrids and *Populus nigra* var. *italica*) perform significantly better under different soil moisture and soil texture conditions than the native one. Furthermore, the effect of intra- and interspecific competition on survival rate and growth performance of *S. humboldtiana* cuttings was investigated. The results of three-factorial ANOVAs and mixed effects models indicate that the invasive *Salix* hybrids performed significantly better than *S. humboldtiana* and *P. nigra* under all treatment combinations. However, almost no intra- and interspecific competition effects could be observed on the survival rate or growth performance of *S. humboldtiana* after 6 weeks. It is expected that these effects will become more relevant in the final phase of the ongoing experiment. The results of this study emphasise that vegetative reproduction capacities can be a crucial point for the success of invasive willow hybrids in Patagonia and indicate a potential threat to *S. humboldtiana*.



## SESSION 09 – BIODIVERSITY ALONG LATITUDINAL AND ALTITUDINAL GRADIENTS

CONVENOR: ANNETTE KOLB, KRIS VERHEYEN, BENTE J. GRAAE, PIETER DE FRENNE

### ORAL PRESENTATIONS:

#### **Germination requirements and seed mass of slow- and fast- colonizing temperate forest herbs along a latitudinal gradient**

*Bente Jessen Graae*<sup>1</sup>, Kris Verheyen<sup>2</sup>, Annette Kolb<sup>3</sup>, Martin Hermy<sup>4</sup>

<sup>1</sup> Department of Biology, NTNU (Norwegian University of Technology and Natural Sciences

<sup>2</sup> Ghent University

<sup>3</sup> University of Bremen

<sup>4</sup> K. U. Leuven

Predictions on displacement of suitable habitats due to climate change suggest that plant species with poor colonization ability may be unable to move fast enough to match forecasted climate-induced changes in habitat distribution. However, studies on early Holocene plant migration show fast migration of many plant species that are poor colonizers today. We hypothesize that warmer temperatures during the early Holocene yielded higher seed quality, contributing to explaining the fast migration. We studied how the 3 seed quality variables, seed mass, germinability, and requirements for break of seed dormancy, vary for seeds of 11 forest herb species with varying colonization capacity collected along a 1400-km latitudinal gradient. Within species, seed mass showed a positive correlation with latitude, whereas germinability was more positively correlated with temperature (growing degree hours obtained at time of seed collection). Only slow-colonizing species increased germinability with temperature, whereas only fast-colonizing species increased germinability with latitude. These interactions were only detectable when analyzing germinability of the seeds, even though this trait and seed mass were correlated. The requirement for dormancy break did not correlate with latitude or temperature. The results indicate that seed development of slow colonizers may be favoured by a warmer climate, which in turn may be important for their migration capacity.



**Phenotypic plasticity across latitude: A buffer against climate warming in forest herbs?**

Pieter De Frenne<sup>1</sup>, Bente J. Graae<sup>2</sup>, Kris Verheyen<sup>1</sup>, Martin Hermy<sup>3</sup>

<sup>1</sup>Laboratory of Forestry, Ghent University, Melle-Gontrode, Belgium.

<sup>2</sup>Climate Impacts Research Centre, Umeå University, Abisko, Sweden.

<sup>3</sup>Division Forest, Nature and Landscape, Leuven, Belgium.

Phenotypic plasticity (PP) may be considered a bet-hedging strategy of organisms to prosper across environments. In this respect, PP can help organisms to cope with a changing climate, especially in slow-colonizing plant species that are expected to have difficulties to track the shifting isotherms. We unravelled the relative importance of PP versus genetic control within two widespread slow-colonizing European forest herbs (*Anemone nemorosa* L. and *Milium effusum* L.) along a 1900-2300km latitudinal gradient by comparing the germination and seedling performance of in situ with ex situ seeds in a common environment (growth chambers). In situ seeds were collected in 14 (*Anemone*) and 16 (*Milium*) populations along the latitudinal gradient and grown in three temperature regimes, whereas ex situ seeds (only for *Milium*) were collected in each of three common-garden sites (containing the 16 populations) located along the same north-south transect. *Anemone* seedlings resulting from in situ seeds showed no latitudinal variation in PP to temperature, whereas the PP of *Milium* seedlings increased to the north. Moreover, the *Milium* seedlings of the ex situ seeds performed better when the mother plant was grown closer to the home-site. Hence, PP and genetic control seem to exhibit a complex interplay in the performance of these forest herbs across latitudes.



## Phenotypic plasticity of forest herbs along environmental gradients in the context of climate change

Isgard Lemke<sup>1</sup>, Annette Kolb<sup>1</sup>, Martin Diekmann<sup>1</sup>

<sup>1</sup> Institute of Ecology, University of Bremen

Phenotypic plasticity is the ability of an organism to express different phenotypes under different environmental conditions. It may buffer individuals both against short-term environmental fluctuations and the long-term effects of global change. A plastic behavior in response to changes in the environment may be especially important in forest herbs, which often have low migration rates and colonization capacities. In this study, we compared the phenotypic variation of five forest herbs (*Brachypodium sylvaticum*, *Circaea lutetiana*, *Impatiens noli-tangere*, *Sanicula europaea* and *Stachys sylvatica*) between two regions in Germany with different temperature regimes (Bremen in the NW, Freiburg in the SW; 5 species × 50 individuals × 15 populations × 2 regions). In addition, we measured light intensity and important soil parameters in all populations. In two species (*B. sylvaticum*, *S. sylvatica*) the variability of several morphological and reproductive traits differed between SW- and NW-Germany when taking differences in environmental conditions into account. Both species showed a distinct higher phenotypic variation under warmer climatic conditions. The other species also varied in their trait plasticity, but there were no clear relationships between this variability and differences in temperature. We conclude that at least some forest herbs have a higher plasticity under a higher temperature regime, which may affect their capacity to respond to global environmental change.



**Isolation by elevation in a subtropical dominant tree**

Miaomiao Shi<sup>1</sup>, Stefan Michalski<sup>1</sup>, Xiao-Yong Chen<sup>2</sup>, Walter Durka<sup>1</sup>

<sup>1</sup> Community Ecology, UFZ

<sup>2</sup> School of Resources and Environmental Sciences, East China Normal University

Plant populations growing along elevational gradients have been found to show inconsistent patterns in the distribution of genetic variation. Studies using molecular markers are usually targeting neutral processes shaping these patterns, but may also be affected by selection. In the present study, diversity and differentiation among 24 populations of *Castanopsis eyrei* were analysed by eight microsatellite loci to test the effects of elevation and successional stage on genetic diversity. One of the loci (Ccu97H18) was potentially under divergent selection as it strongly deviated from a neutral model of differentiation among populations. The analysis showed that *C. eyrei* populations had a high level of genetic diversity within populations ( $HE = 0.80$ ), as expected from its life history characteristics like wind pollination and long life time. Genetic variation increased with elevation for both the putatively selected locus Ccu97H18 and the neutral loci. At the locus Ccu97H18 one allele was dominant at low elevations, which was replaced at higher elevations by an increasing number of other alleles. The level of genetic differentiation at neutral loci was similar to that of other Fagaceae species ( $F_{ST} = 0.032$ ,  $= 0.15$ ). Population differentiation did not follow a model of isolation by distance but significant isolation by elevation was found, both for all and the neutral loci, indicating higher gene flow among similar altitudinal levels than across different altitudinal levels.



**Lessons from altitudinal gradients: Niche evolution and range margins of alien species***Jake Alexander*<sup>1</sup>, Peter Edwards<sup>1</sup><sup>1</sup> Institute of Integrative Biology, ETH Zurich

What determines the limits to genetic adaptation? This is a question of great theoretical and practical importance when considering the ability of species to respond to rapid climate change. Alien plant invasions have shown that genetic differentiation among populations is widespread and can arise rapidly. However, despite possible local adaptation, all species are limited at some point along environmental gradients in their introduced range, just as they are in the native range. Normally the limits are the same in both regions (niche stasis), although differences (niche shifts) have recently been documented. We propose that comparative studies of alien species along environmental gradients can therefore provide a tool to understand limits to adaptation. For example, introduced *Lactuca serriola* populations from North America bolt faster, and consequently have higher limits along altitudinal gradients, than native Swiss populations. The failure of native populations to evolve similar limits might be explained by their lower genetic variability and connectedness. When species are limited in this way, niche evolution might be promoted by the mixing of individuals from different sources. We suggest conditions under which niche shifts during plant invasions are most likely. Such understanding will help to predict and mitigate anthropogenic impacts on species ranges.



**Macroecological lessons from Siberian mayflies – The Rapoport effect and why species with wider altitudinal ranges have narrower geographical distribution?**

*Mikhail Beketov*<sup>1</sup>

<sup>1</sup>Department of System Ecotoxicology, UFZ - Helmholtz Centre for Environmental Research

Three hypotheses were tested: (i) patterns of cross-Eurasian longitudinal distribution of lotic mayflies are determined by species' ecological requirements and the presence of the West Siberian Lowland (WSL), (ii) the Rapoport effect is valid for the altitudinal distribution of mayflies over the large-scale river continuum, and (iii) the observed Rapoport effect is based on high nestedness of the meta-assemblage, implying the presence of a common species pool and species-thinned nested subsets. The results showed that (i) for most of the East Palaearctic (but not Transpalaearctic) species WSL can be an environmental barrier preventing their westward dispersal and therefore precluding mixing of the East and West Palaearctic rheophilic faunas. (ii) The Rapoport effect was demonstrated: species altitudinal ranges expanded with increase in the ranges' midpoints and average per-altitude ranges increased with increase in altitude and concurrent decrease in species richness. (iii) Nestedness analysis revealed that the observed Rapoport effect is based on nested organization: a common species pool at low (but not the lowest) altitudes and nested subsets of this pool at higher altitudes.



## Effects of habitat fragmentation on two specialist herbivores along an altitudinal gradient in the Tongariro National Park, New Zealand

Claas Damken<sup>1</sup>, George Perry<sup>1</sup>, Jacqueline Beggs<sup>2</sup>

<sup>1</sup> School of Environment, The University of Auckland

<sup>2</sup> School of Biological Sciences, The University of Auckland

Climate change and landscape fragmentation are two major threats for global terrestrial biodiversity. In particular, habitat size, habitat quality and isolation are influenced by climate change and landscape fragmentation. Within the concept of meta-population biology, the survival of species in fragmented landscapes is mainly due to these three environmental factors. To cope with rising temperatures, stenotherm species such as mobile insects may migrate to higher and therefore cooler regions. However, at increasing altitudes, habitat quality can change. Spatial and temporal “bottlenecks” are a particular risk, especially for monophagous insects e.g. if the appropriate host plants are still restricted to lower altitudes. This project investigates whether increases in population dynamics along an altitudinal gradient will result in higher species requirements of habitat quality and habitat size. Spatial distribution of the endemic scrub species *Hebe stricta*, habitat quality and abundance of two herbivore specialists, *Trioza obscura* (Homoptera: Psylloidea) and an unknown gall midge (Diptera: Cecidomyiidae), were mapped along a subalpine stream system in the Tongariro National Park, New Zealand. The talk will present first results of the effects of habitat fragmentation on monophagous insects and their host plants along altitudinal gradients.



POSTER PRESENTATION:**Effects of altitudinal on population genetic structure and clonal growth in *Briza media***

*Thomas Hahn*<sup>1</sup>, Chris J. Kettle<sup>1</sup>, Andrea R. Pluess<sup>1</sup>, Jaboury Ghazoul<sup>1</sup>

<sup>1</sup> ETH Zürich

As plant populations in mountainous regions experience increasing environmental stress at higher altitudes, populations at the upper range periphery are exposed to the harshest climatic conditions. Theory states that as a function of differences in population size and the degree of isolation, neutral genetic diversity will be lower and genetic differentiation will be more pronounced in upper peripheral compared to lower central populations. In the common grassland species *Briza media* we compared genetic diversity and differentiation in ten pairs of lower central (1200m a.s.l.) and upper peripheral (1800m a.s.l.) populations throughout the Swiss Northern Alps using AFLP fingerprints. First results show that upper peripheral populations show higher genetic differentiation but contrary to expectations there was no effect of altitude on neutral genetic diversity, which might be explained by the impact of landuse on potential habitat areas. In a next step we investigate, whether upper peripheral populations might be adapted to current climatic conditions in terms of their reproduction mode. The success of sexual reproduction in upper peripheral populations can be hampered due to decreased germination and seedling establishment caused by the shorter vegetation period. Therefore clonal reproduction, which requires less resources, is among the major survival strategies in plants growing on high altitudes. Increased clonal reproduction should lead to larger clones and lower clonal diversity at high altitudes. In *B. media* we investigate clone sizes on three different altitudes (900 – 2000m a.s.l.) in three valleys in Graubünden, Switzerland using AFLPs and will present preliminary results of this study.



## SESSION 10 - CLIMATE CHANGE EFFECTS ON THE SPECIES AND ECOSYSTEM LEVEL

CONVENOR: CAMILLA WELLSTEIN, CARL BEIERKUHNEIN, JÜRGEN KREYLING & MICHAEL SCHERER-LORENZEN

### ORAL PRESENTATIONS:

#### **Homogenization of European summit floras under global warming**

*Gerald Jurasinski*<sup>1</sup>, Jutta Kapfer<sup>2</sup>, Kari Klanderud<sup>2</sup>, Gian-Reto Walther<sup>3</sup>, John-Arvid Grytnes<sup>2</sup>

<sup>1</sup> Landscape Ecology and Site Evaluation, University of Rostock

<sup>2</sup> Ecological and Environmental Change Research Group, University of Bergen/Norway

<sup>3</sup> Plant Ecology, University of Bayreuth

Range shifts (upward shifts) of species in mountain ecosystems have been studied across the globe in several studies. Here we bring together many of the European studies on that subject to answer a question beyond the change in plant species richness on mountain summits. We analyze whether the upward shift of species leads to a homogenization of mountain summit floras, that means, to an increase in floristic similarity between neighboring summits and address whether the effect is consistent across latitude in Europe and how it depends on scale. The analysis bases on a 111 summits data set that spans a latitudinal gradient of more than 4000 km whilst having a small longitudinal extent with first vegetation records from about 1900 to the 1950s and last vegetation records from 1990 to 2009. The similarity between all summits and its immediate neighbors is calculated for each time step and compared across time. This is done for several neighborhoods for each summit which are achieved by constructing circular buffers with increasing radii. All neighboring summits within a buffer are used for similarity calculation. Such, the scale dependence of the homogenization effect can be analysed. Further, the differences in similarity between the two recordings for each summit are plotted against latitude. This reveals an interesting overall latitudinal pattern: Whilst in the South homogenization prevails, heterogenization happens in the North independent from buffer size.



**Projection of habitat-specific plant species pools under climate change**

Sven Pompe<sup>1</sup>, Franz Badeck<sup>2</sup>, Jan Hanspach<sup>1</sup>, Stefan Klotz<sup>1</sup>, Helge Bruehlheide<sup>3</sup>, Ingolf Kühn<sup>1</sup>

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<sup>3</sup> Institute of Biology / Geobotany and Botanical Garden, Martin Luther University Halle-Wittenberg, Halle, Germany

By extending common species distribution modelling approaches, here, we present a method for analysing habitat-specific plant species assemblages of 474 species within regional species pools in Germany using lattice data. We quantified the change of species composition in a grid cell under three given scenarios and the impact on species co-occurrence in habitat-specific species pools between the climate normal period (1961-90) and a scenario period (2051-80). Our results suggest that the degree of co-occurrence of species will decline across the scenarios, e.g. by  $24 \pm 13\%$  (mean  $\pm$  s.d.) under a severe climate change scenario (average change  $+3.8^\circ\text{C}$  up to 2080). Species responses strongly vary among the tested major habitat types with a minimum average projected range loss of 14% ( $\pm 18\%$ ; species typical to urban habitats under moderate climate change assumptions, average temperature increase  $+2.2^\circ\text{C}$ ) to a maximum average projected range loss of 56% ( $\pm 29\%$ ; species assemblages from mountain communities below the alpine zone at  $+3.8^\circ\text{C}$ ). The results suggest that habitat-specific species assemblages within regional species pools might particularly decrease for certain habitat types (e.g. species assemblages near or above treeline, dwarf scrub communities below alpine areas) while it might increase under moderate climate change assumptions for urban formations.



## **Are cool types mild guys?**

*Dominik Katterfeldt<sup>1</sup>, Ingolf Kühn<sup>1</sup>, Martin Nebel<sup>2</sup>*

<sup>1</sup> Helmholtz Zentrum für Umweltforschung UFZ

<sup>2</sup> Staatliches Museum f. Naturkunde

We modelled regional effects of climate change on plants. Astonishingly, our results show a decrease in the number of colonized grid cells within thermophilous species whereas plants in higher elevations seem to become more frequent. Drought-adapted plant species respond as expected; as do those from moist habitats.

We relate these observations to life forms which has ecological importance regarding extant of winter and summer extremes. Thus, plants living in colder spots seem to profit from milder winter temperatures.



**Rapid recovery of diversity through long-distance pollen dispersal in a northern pioneer population of holm oak (*Quercus ilex*)**

Arndt Hampe<sup>1</sup>, Rémy J. Petit<sup>2</sup>

<sup>1</sup> Estación Biológica de Doñana, Consejo Superior de Investigaciones Científicas (CSIC)

<sup>2</sup> UMR 1202 BIOGECO, Institut National de la Recherche Agronomique (INRA)

Modern climate change is generating extensive poleward range expansions of numerous plant species worldwide. These occur typically through the successive establishment and growth of pioneer populations well ahead of the continuous species range, and it remains little known how such populations recover from the strong loss of genetic diversity they experience during the founder event. We investigated a pioneer population of holm oak (*Quercus ilex*) growing >30 km ahead of the nearest larger populations. Two generations were distinguished, whose genotypes allowed to reconstruct those of two original founder trees. The four reproductive trees present today, all full-sibs, showed unexpectedly divergent patterns of cross-compatibility. Around 5% of the acorns analysed (n = 255) contained genotypes resulting from pollen immigration. This fraction rose to 20% among the 60 established seedlings and saplings growing in the area. Our results suggest that pioneer populations of wind-pollinated tree species can restore their genetic diversity very quickly through a combination of regular long-distance pollen flow and efficient purging of inbred individuals during recruitment.



**Rapid evolutionary alteration of eco-physiological and fitness related traits of plants in response to elevation of carbon dioxide concentration and temperature**

Georg Freneck<sup>1</sup>, Leon van der Linden<sup>2</sup>, Teis N. Mikkelsen<sup>2</sup>, Hans Brix<sup>3</sup>, Rikke B. Jørgensen<sup>2</sup>

<sup>1</sup> Biosystems Division, Risø/DTU, Technical University of Denmark; Plant Biology, Århus University

<sup>2</sup> Biosystems Division, Risø/DTU, Technical University of Denmark

<sup>3</sup> Plant Biology, Århus University

Natural selection is likely to progressively modify plant responses to increasing [CO<sub>2</sub>] and temperatures, leading to response patterns different to those detected initially. Yet, current knowledge of evolutionary trajectories under environmental change is poor. This experiment employed a controlled selection regime to examine single and combined evolutionary consequences of [CO<sub>2</sub>] and temperature elevation on plant populations; integrating genotypic variability in the potential adaptive responses over five generations. Trans-generational alterations of initial eco-physiological and biomass responses were revealed in four *Brassica napus* genotypes. Alterations of initial responses to [CO<sub>2</sub>] were mostly unidirectional, while the trans-generational responses to temperature were more variable and did not provide a common pattern for the different genotypes. It was shown that a positive selection, driven by elevated [CO<sub>2</sub>], can potentially act to restore depressions in plant fitness caused by elevated temperature, in situations where these factors co-occur. It is suggested that evolutionary change of plant traits may lead to future biogeochemical dynamics and long-term trends of plant fitness which are different from projections that do not consider evolutionary change. Our experiment demonstrates the importance of evolutionary responses to environmental change in relation to our understanding of future ecosystem structure, function and biodiversity.



**Biodiversity and ecosystem function under simulated climate change**

Lars R. von Riedmatten<sup>1</sup>, Carsten F. Dormann<sup>1</sup>, Michael Scherer-Lorenzen<sup>2</sup>

<sup>1</sup> Department of Computational Landscape Ecology, Helmholtz Centre for Environmental Research - UFZ Leipzig

<sup>2</sup> Faculty of Biology, University of Freiburg

Climate change and loss of biodiversity are two concurrent environmental trends and important ecological research areas. For model systems it has been shown that diverse plant communities are to some extent able to buffer negative effects of climate change on ecosystem processes: To better understand the relationship between biodiversity and ecosystem functions, such as productivity and litter decomposition, under climate change we conducted a manipulative experiment within the framework of the Biodiversity-Exploratories in Germany. We simulated earlier onset of the growing season in spring by raising temperature and the occurrence of extended drought periods in summer by excluding rainfall. A total of 45 experimental plots at three study sites (Schorfheide, Hainich, Schwäbische Alb) covering three land use types (meadow, pasture, mown pasture) were established. In order to test the insurance hypothesis we harvested above and below ground biomass at several times per year and recorded species composition and richness. To quantify litter decomposition, above ground litter and senescent corn roots were incubated in litterbags. Simulated summer drought had a general negative effect on above ground productivity and litter decomposition but increased the root to shoot ratio. The earlier onset of the growing season showed a positive effect on above ground productivity. Species rich communities tended to maintain higher levels of ecosystem function under simulated climate change.



**Plant performance under simulated climate change strongly depends on land use type, study region, and species identity**

*Astrid Bütof*<sup>1</sup>, Lars R. von Riedmatten<sup>2</sup>, Carsten F. Dormann<sup>2</sup>, Michael Scherer-Lorenzen<sup>3</sup>, Erik Welk<sup>1</sup>, Helge Bruelheide<sup>1</sup>

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<sup>3</sup> Faculty of Biology / Geobotany, University Freiburg

The impact of climate change in interaction with land use dynamics on plant species distribution is a current research focus. However, species of different distribution types and thus, different climatic niches (e.g. oceanic or continental) might respond differently to changing climate and land use. Within the framework of the Biodiversity-Exploratories in Germany we conducted an experimental field approach. Climate change (earlier start of growing season, summer drought) was simulated in 45 experimental plots including three study sites (Schorfheide, Hainich, Schwäbische Alb) and three land use types (meadow, pasture, mown pasture). In order to test for different responses of species belonging to different geographic range types we recorded survival and growth of three planted species pairs. Each pair consisted of two congeneric species with different geographic distribution but similar growth form and habitat type. Distribution data of the target species were collected, mapped and analysed to quantify differences in species macroclimatic niches. The simulated climate change had a general negative effect on plant survival, irrespective of range type. Growth performance of the surviving plants was species-specific and varied with land use type and study site but did also not differ between range types. In conclusion, species with similar climatic niches can be expected not to respond consistently to the interaction of climate change with land use.



**Global climate change – Only bad news for boreal forest herb layer species?**

Kathrin Kirchner<sup>1</sup>, Helge Bruelheide<sup>1</sup>

<sup>1</sup> Martin Luther University Halle Wittenberg

Global change, with increasing temperatures as well as changing precipitation regimes will have a severe impact on species distribution. This also applies to boreal herb layer species (*Trientalis europaea*, *Calamagrostis villosa*) in montane spruce forests at Mt. Brocken (Harz National Park, Germany). However, the negative influences might be counteracted by more favourable light regimes as extreme weather situations are supported to create more gaps. We hypothesized that (1) these species benefit from higher light availability, (2) there is a negative interaction of increasing temperature with increasing light intensity, because more open conditions are linked to higher temperatures and vapour pressure. We established a common garden experiment with a split-plot design at 2 sites (Mt. Brocken, Halle), 3 light regimes and 5 clones of each of the two species. Under full shade, the biomass of *T. europaea* and *C. villosa* was very small compared to high light conditions, thus confirming the first hypothesis. However, in contrast to our second hypothesis, *C. villosa* at the full light treatment at the warm site turned out to be the most favourable one, with the highest number of stems per tussock, and not as expected (half)shade conditions at the warm and full light at the cold site. Thus, our experiment showed that grass and herb species might benefit from increasing temperatures under climate warming. In consequence, it might be that boreal species are less affected than anticipated.



**Local adaptation to drought and warming in four common grass species**

Daniel Thiel<sup>1</sup>, Jürgen Kreyling<sup>1</sup>, Anke Jentsch<sup>1</sup>, Carl Beierkuhnlein<sup>1</sup>

<sup>1</sup> Department of Biogeography, University of Bayreuth

Below species level, ecotypes may differ in performance under climate change due to genetic diversity. To make use of this intraspecific diversity might be one method within the range of potential climate change adaptation tools. Hence, it is important to identify differences in the reaction of ecotypes to projected climate scenarios. We selected provenances for four grass species on the basis that climate of the origin was similar to future projections for our site. The selection was compared to local provenances in a pot experiment under warming (+1.5°C) and drought in a fully factorial design. Biomass production was measured as response variable. Results imply that local adaptation occurs mainly with respect to drought. Both provenance and drought significantly influence biomass production of three species. A significantly different drought tolerance (interaction of provenance and drought) was detected for *A. elatius*. The warming did not trigger any effects on productivity. Furthermore, the differences between the experimental climate and the climatic conditions at the origin of the provenances and their influence on performance are discussed. This range of ecological performance within species has to be considered, in order not to overestimate the plasticity of species in common modelling approaches. Provenance research is urgent to identify ecological and genetic plasticity in the face of climate change and may help maintaining natural ecosystems and avoid the use of exotic species.



**Extreme weather events alter flower phenology of *Calluna vulgaris* and *Genista tinctoria***

Laura Nagy<sup>1</sup>, Kreyling Jürgen<sup>2</sup>, Beierkuhnlein Carl<sup>2</sup>, Jentsch Anke<sup>2</sup>

<sup>1</sup> Physische Geographie, Universität Landau

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Shifts in the phenology of plant are seen as “fingerprints” of global warming. Here we report extreme events: severe drought and heavy rain events. We present data from four vegetation periods in an experimental setting containing the phenological response of *Calluna vulgaris* and *Genista tinctoria* to simulated 100 and 1000-year extreme weather events in Central Europe (EVENT experiment). On the basis of onset, midday and length of flowering we present the phenology of 2006 to 2009. Phenology is a natural event in relation to climate. The temperature two months before flowering onset appear is crucial for the growing season of a year. We correlate the data with temperature sums to evaluate the correlation of the onset and mid-flowering days with the temperature. Drought significantly delays the mid-flowering date of *Genista tinctoria* 2006 by 33 days, 2007 by 25 days and 2009 by 32 days. Heavy rainfall significantly advanced the mid-flowering day of *Genista tinctoria* 2008 by 57 days. Drought had no significant effect on flowering length. Heavy rainfall significantly expanded the flowering length of *Genista tinctoria* 2008 by 56 days. Drought and heavy rainfall had no significant effect on mid-flowering of *Calluna vulgaris*. Drought significantly expanded the flowering length 2008 by 10 days and 2009 by 6 days. Heavy rainfall significantly shortened flowering length of *Calluna vulgaris* 2006 by 4 days.



**Impacts of sea level rise on the decomposition rate of the eelgrass *Zostera muelleri****Andrea Nicastro*<sup>1</sup><sup>1</sup> Department of Biological Sciences, Macquarie University, Sydney

Global climate change can directly affect decomposition processes by changing the physical environment in which decomposition occurs, and indirectly by modifying the quality of detritus derived from plants. I evaluated primary and secondary effects of future sea level rise on the decomposition rate of the eelgrass *Zostera muelleri*, an abundant macrophyte inhabiting temperate Australian estuaries. Under sea level rise, the intertidal zone of Australia's urbanized estuaries will be reduced because seawalls will prevent landward migration of the shoreline. *Z. muelleri* shows an acclimative plasticity along the vertical shore gradient, resulting in spatial differences in the quantity and quality of the foliar material produced. Therefore, the reduction of the intertidal zone may not only lead to an alteration of the physical environment in which decomposition occurs, but also to changes in detritus properties. The extent of intraspecific variability in foliar material quality produced by *Z. muelleri* along the shore vertical gradient were analysed in three estuaries of New South Wales. Additionally, a litter bag experiment was performed to study the influence of the duration of aerial exposure and litter quality on the decay rate of *Z. muelleri* leaves. Results showed that future sea level rise has the potential to alter detrital resources of estuaries and to speed up recycling of the decaying foliar material with large implications for higher trophic levels.



**Effects of climate change on ecosystem functions**

*Camilla Wellstein*<sup>1</sup>, Carl Beierkuhnlein<sup>1</sup>, Jürgen Kreyling<sup>1</sup>, Franziska Niemitz<sup>1</sup>, Anke Jentsch<sup>2</sup>

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Ecosystem services and the underlying ecosystem functions are highly discussed issues within the scientific community in recent years especially in close connection with climate change. Indeed, current climate change is an important interference on ecosystem functioning and according to climate change scenarios we will face further severe alterations in the upcoming decades. However, our body of knowledge is still too small to predict the outcome of these changes to ecosystem functions. To give an overview of the research on ecosystem functions and services in connection with climate change we made a formalized literature search in the ISI-Web of Science. We found over thousand papers and little experimental driven research on the effects of climate change on ecosystem processes and functions as less than 4% account to this stream of research. While extant experimental studies investigate mainly the ecosystem services of nutrient cycling, primary productivity and stability, research on the climate change impact on biological diversity, phenology, gas exchange, water regulation and reproductive fitness is scarce. Response of ecosystem functions and services to climate change affected phenomena such as fire and freeze-thaw cycles are particularly rarely studied. However, evidence shows that these phenomena are in particular highly sensitive to climate alterations.



## The importance of winter climate change on ecological processes

*Jürgen Kreyling*<sup>1</sup>

<sup>1</sup> Biogeography, University of Bayreuth

Winter ecological processes are important drivers of ecosystem functioning in temperate ecosystems. There, winter conditions are subject to rapid climate change. The potential loss of a longer-lasting snow cover with implications to other ecologically important climate parameters makes the temperate zone particularly vulnerable to winter climate change. Trends in the occurrence of soil frost and snow cover based on climate data series of 150 German Weather Service stations and regional climate modelling approaches (REMO) are presented. Examples from own experiments indicate the strong and lasting effects of winter warming pulses on species composition, productivity and nutrient availability. Root injury and mycorrhizal community composition (ITS-sequencing) have been tested as causal drivers of the observed effects. A formalized literature search in the ISI-Web of Science finally shows that research on the effects of winter climate change is generally underrepresented. Temperate regions in particular are rarely studied in this respect, although the few existing studies imply strong effects of winter climate change on species ranges, species compositions, phenology, or frost injury. I conclude by discussing gaps in current knowledge such as the understanding of the relative effects of interacting climate parameters, as well as a stronger consideration of shortterm events and variability of climatic conditions.



## **Impact of extreme weather events on the microbial function of soil**

*Verena Hammer*<sup>1</sup>, Carl Beierkuhnlein<sup>2</sup>, Anke Jentsch<sup>3</sup>, Michael Schloter<sup>4</sup>, Karin Pritsch<sup>4</sup>

<sup>1</sup> TU München

<sup>2</sup> University of Bayreuth

<sup>3</sup> University of Landau

<sup>4</sup> Helmholtzzentrum München

Prolonged drought periods as predicted in future climate scenarios will affect ecosystem functions in multiple ways. Water stress not only affects plants but also soil microorganisms. As important soil functions, nutrient turnover processes will be affected during the vegetation period when plants have highest demands. Drought is one of the factors addressed in the EVENT-Experiment established at the Botanical Garden of the University of Bayreuth. In this project, we hypothesise that hydrolytic enzyme activities will be reduced and oxidative processes will be favoured under drought conditions. Therefore, biochemical parameters such as soil enzymatic activities of hydrolytic (phosphatase, chitinase, proteases, cellulases, hemicellulases) and oxidative enzymes (phenoloxidases, peroxidases) are measured. In addition the gene and transcript pool of these enzymes will be studied using molecular biological studies on nucleic acids extracted from soil (chitinase, cellulases, xylosidase). The project focuses on experimental and natural grassland communities. First results will be presented on drought effects (1000 year extremes) and an outline of the overall design of the study is presented.



**Effects of intra-annual rainfall variability on productivity of semi-natural grassland communities**

*Kerstin Grant*<sup>1</sup>, Jürgen Kreyling<sup>1</sup>, Carl Beierkuhnlein<sup>1</sup>, Anke Jentsch<sup>2</sup>

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Extreme weather events are expected to increase in frequency and magnitude due to climate change. Additionally, greater intra-annual rainfall variability is predicted for many regions on earth. However their effects on vegetation and ecosystem functions are widely unknown. We tested the effect of different precipitation regimes– minimal, ambient, and extreme variability on the aboveground productivity of grassland communities in a field experiment (EVENT II). The extreme variability manipulation was applied in two scenarios, one with an extreme drought in spring and the other with an extreme drought in summer. Annual precipitation sum was kept constant. The precipitation manipulations were furthermore crossed with two mowing regimes – two and four times per year. Aboveground net primary productivity (ANPP) of grassland communities was reduced by the extreme variability manipulations compared to the minimal variability treatment. ANPP of communities under extreme precipitation regimes, however, did not significantly differ from those under ambient weather conditions. Furthermore, timing of drought and mowing regime had no significant effects on ANPP. We conclude that productivity of grassland communities is fairly resilient against changes in the variability of precipitation regimes.



## Extreme weather events and plant community diversity influence herbivore performance

Julia Walter<sup>1</sup>, Kerstin Reifenrath<sup>2</sup>, Roman Hein<sup>3</sup>, Carl Beierkuhnlein<sup>3</sup>, Anke Jentsch<sup>4</sup>

<sup>1</sup> Conservation Biology, Helmholtz Centre for Environmental Research- UFZ

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Climate change is projected to increase frequency of severe droughts as well as days of extreme precipitation events. This affects plant survival, plant growth and secondary metabolism. Changes in plant metabolites in turn affect herbivores. We investigated i) how extreme weather events impact leaf traits and the performance of herbivores and ii) whether plant community diversity alters leaf traits and the performance of herbivores. We conducted a feeding experiment, in which we fed *Holcus lanatus* (Poaceae) to freshly hatched *Spodoptera littoralis* larvae (Lepidoptera). *H. lanatus* was grown in plant communities differing in species richness and functional groups. Communities were treated with either extreme drought (D) or heavy rain (R) or remained under ambient conditions (C). We measured metabolites of leaves of *H. lanatus* and developmental parameters of *S. littoralis*. Mortality of larvae was highly increased when reared on *H. lanatus* out of most species rich communities without legume. Changes in metabolites under drought strongly affected caterpillar larvae, as they developed significantly slower. However, pupae weighed more and percentage of eclosion was higher than in larvae fed with control leaves. We conclude that on the one hand diversity affects herbivore performance. On the other hand, biodiversity will be affected by extreme climatic events through alterations in plant chemical compounds, which in turn might affect food webs and synchronization between species.



## **Simulating the influence of climate change on soil moisture regimes in Namibia**

*Susanne Meyfarth<sup>1</sup>, Britta Tietjen<sup>2</sup>, Alexander Gröngröft<sup>3</sup>, Florian Jeltsch<sup>1</sup>*

<sup>1</sup> *University of Potsdam*

<sup>2</sup> *Potsdam Institute for Climate Impact Research*

<sup>3</sup> *University of Hamburg*

The predicted climate change for southern Africa affects different aspects of climate: increase of temperature, decrease of mean annual precipitation, increase of extreme rainfall events. For all of these aspects an effect on soil moisture is obvious or at least probable. This is important in savannas of southern Africa, as vegetation dynamics is strongly related to soil moisture and a change in the moisture regime can possibly lead to degradation.

The extent to which climate change leads to changes in soil moisture might be different for different soils. We investigate this relationship systematically using a modelling approach. We use a spatially-explicit and process-based hydrological model, which simulates the water availability in two soil layers. The model is designed in a generic way and is applied to three different savanna sites along a rainfall gradient in Namibia. For each site, we assume different soil textures and vegetation states and examine the influence of predicted climatic conditions compared to current climatic conditions.



POSTER PRESENTATIONS:

**Adaptive or passive response to climate change?**

*Sabine Hänel*<sup>1</sup>

<sup>1</sup> Plant Ecology, Uni Tübingen

As a consequence of climate change, decreasing annual precipitation and increasing unpredictability of rain events are expected to put the vegetation in Mediterranean and semi-arid environments under a strong selection pressure. To imitate those effects a long time project of rain manipulation (30% reduction, control and 30% increase of precipitation) was set up at two sites in Israel characterised by semi-arid and Mediterranean conditions, respectively. Here, we study phenotypic and genetic shifts in phenological and morphological traits on dominant annual plant species in response to nine years of climate manipulation in the field. In the first season, we have monitored individuals of 18 most abundant species with respect to key traits indicating potential microevolutionary change. Detected differences in the measured traits will be tested in an two-generations-experiment to distinguish between plastic response and genetically fixed adaptation.



**Impact of climate change on biotic interactions**

*Ellen Gellesch*<sup>1</sup>, Roman Hein<sup>1</sup>, Carl Beierkuhnlein<sup>1</sup>, Anke Jentsch<sup>2</sup>

<sup>1</sup> Biogeography, University of Bayreuth

<sup>2</sup> Geoecology / Physical Geography, University of Koblenz-Landau

Recent evidence suggests shifts in biotic interactions due to climate change. Such shifts potentially lead to the seasonal alteration of interaction patterns, decoupling of coevolved species, partial substitution by novel partners or even loss of functional performance. However, the body of scientific literature is small. Up to date, a growing number of studies have focused solely on changing species distribution patterns under climate change. Here, we 1. Identify which biotic interaction types including plant-plant, plant-animal, plant-microorganism and animal-animal are most sensitive to changing climatic drivers. Within the climatic drivers, we distinguish between trends such as temperature increase, precipitation increase, CO<sub>2</sub>-enrichment and events such as drought and heavy rain. 2. We quantify research activity on the interaction types including information on the species groups examined. 3. We disentangle the methodological approaches applied according to monitoring, experiment and modeling. We found concrete results for interaction types and climatic drivers. 90% of the research takes place in the temperate zone of North America and Europe, with most studies equally representing forests and grasslands. The best examined interaction type is that of plants and their insect herbivores studied by means of field experiments. For long-term studies, field observations prevail. Generally, emerging fields of research are in multitrophic and multiple-partner biotic interactions.



**Breeding during contrasting environmental conditions: Influence of ENSO in a colony of Burrowing Parrots at the Atlantic coast of Patagonia**

Juan F. Masello<sup>1</sup>, Petra Quillfeldt<sup>1</sup>

<sup>1</sup> Vogelwarte Radolfzell, Max-Planck-Institut für Ornithologie

The main factors causing current changes in biodiversity are changes in land-use and climate change. Climate change is expected to lead to striking changes in the composition and viability of many ecosystems and populations. Among changing climatic cycles with a great influence on ecosystems worldwide is the El Niño Southern Oscillation (ENSO). Although the effects of climate change on ENSO oscillations are difficult to predict, recent high-resolution climatic models suggest that the frequency of ENSO conditions is increasing. The increased frequency of ENSO conditions affects bird populations in several regions of our planet. In South America, the Burrowing Parrot (*Cyanoliseus patagonus*) populations of coastal North-eastern Patagonia are among the affected birds. The breeding area experiences dry conditions during the La Niña phase of the ENSO phenomenon and highly increased rainfall during the years of El Niño. Our data suggested a strong influence of ENSO on adult body condition and immune capacity, the timing of breeding, nestling survival and growth in Burrowing Parrots. We here present results of further analyses conducted on a long-term data set based on 7 breeding seasons and comprising four ENSO events. We investigated how the unpredictable conditions of both phases of ENSO influence breeding success of Burrowing Parrots and discuss how the increased frequency of such dramatic climatic events could affect the viability of the species.



**Adaption of silver fir (*Abies alba* Mill.) to a warmer climate - An investigation of the standing variation hypothesis**

Anna Roschanski<sup>1</sup>, Sascha Liepelt<sup>1</sup>, Birgit Ziegenhagen<sup>1</sup>

<sup>1</sup> Universität Marburg

With rising temperatures our European forests are faced with serious changes of their environment. The changes might be too rapid for tree populations to react via migration to more favorable habitats or gene flow from distant populations. Phenotypic plasticity might enable an individual to survive but is likely to be accompanied by a decreased fecundity. The concept of standing variation describes that certain species come with sufficient genetic diversity which provides enough genetic raw material to be offered to evolution. As a result these species should be able to adapt to a changing environment. Our aim is to evaluate the adaptive potential of silver fir (*Abies alba* Mill.) to a warmer climate especially to extended drought periods. How does variation at the gene level behave in the course of natural selection? Does standing genetic variation of *Abies alba* allow for a rapid adaptation when abiotic factors change? We will investigate stands of adult trees on dry sites and on wet sites, respectively. By using next generation sequencing we want to identify genes that are involved in drought stress responses. Trees of both sites shall be compared with respect to the variation within the genes. With the help of statistical models such as neutrality tests or Bayesian approaches we hope to detect patterns of local selection. We will complement this with drought stress experiments in the greenhouse to better understand genotype-phenotype relationships.



## **Sky exposition effect on phenological rhythm and seed set in *Primula* species**

*Natalia Togonidze*<sup>1</sup>

<sup>1</sup> Ilia State University

Research focuses on global climate change effects on the longevity of plant life cycle. The aim of our work was to determine changes in phenological rhythm and seed set related to environmental conditions to reveal the individual plant species adaptation amplitude in specific habitats and to determine their survival chance in the variable environment was another objective of present work.

The effect of sky exposition on phenological rhythm in 6 species of genus *Primula* has been studied in different habitats. The fish-eye lens and computer program "Gap Light Analyzer" were used to determine sky exposition cover percentage.

The results show that early flowering in forest species, especially in more shaded forest species - *P. woronowii*, is determined by acceleration of phenological phases aiming completion of flowering and pollination period before leaves appear in forest and sky exposition and climatic conditions will be changed significantly. Reproductive effort of early flowering forest species -*Primula* shows close correlative relation to microclimatic conditions determined by sky exposition, temperature, moisture and solar radiation. It is expected that the shifts caused by global climate change will effect on "spring index" in forests and will change duration of phenological phases in shaded habitat of *Primula*. These events will have an impact on reproductive success and determine the chances of species propagation and survival.



**Responses of 64 plant species growth traits to climate change**

Yanli Zhuang<sup>1</sup>, Alexandra Weigelt<sup>2</sup>, Christian Wirth<sup>1</sup>

<sup>1</sup> Group Organismic Biogeochemistry, Max Plank Institute of Biogeochemistry

<sup>2</sup> Institute for Special Botany and Functional Biodiversity, University of Leipzig

Global temperatures are predicted to rise by up to 4°C by 2100, with associated alterations in precipitation patterns. Studies showed that climate change alters phenology, growth and reproduction in many species. However, different species and plant traits may react differently to the climate change. We established a global change experimental facility (GCEF) to assess the ecosystem strategies to a sustainable response to climate change. In a common garden experiment, we selected 64 plant species with expected positive reaction to climate change (southwest European distribution) and expected negative reaction to climate change (northeast European distribution), which were subdivided in 4 functional groups (grasses, small herbs, tall herbs, legumes), and carried on the climate treatments by regular watering simulating ideal growth condition and reduced watering simulating drought conditions. Two pot sizes including 2 liter rose pots and 8 liter PVC tubes were used for different research purposes. Therefore, the experiment aims to investigate species with potential positive and negative reaction to global change scenarios differ in above- or belowground traits, the plasticity in species performance change depending on the drought treatment and potential winners and losers react differently.



**Variability of clonal growth of European grass species in climate change experiments**

Camilla Wellstein<sup>1</sup>, Patrizia Paci<sup>1</sup>, Daniel Thiel<sup>1</sup>, Jürgen Kreyling<sup>1</sup>, Anke Jentsch<sup>2</sup>, Roberto Canullo<sup>3</sup>, Diego Competella<sup>3</sup>, Carl Beierkuhnlein<sup>1</sup>

<sup>1</sup> Biogeography, University of Bayreuth

<sup>2</sup> Institute of Environmental Sciences, University of Koblenz-Landau

<sup>3</sup> Environmental Sciences Department, University of Camerino

Current plant functional trait research aims to predict the outcome of land use and climate change at the species, community and ecosystem level. However, there is little insight in the role of the intraspecific variability of these traits. Initial research results suggest that functional variability of plant species may be crucial to adapt to rapidly changing environmental conditions. Here, we investigate the impact of climate change phenomena such as drought and warming on the clonal growth of European key grass species (*Alopecurus pratensis*, *Arrhenatherum elatius*, *Festuca pratensis*, and *Holcus lanatus*). Furthermore we tested for significant differences of five provenances from different climatic regions of Europe (Bulgaria, Spain, Italy, Germany, and Sweden). Clonal diversity and clonal growth was measured for 50 to 100 individuals of each species in a controlled pot experiment. Measures included presence of clonal growth organs (CGOs), number of respective tillers and buds and the capacity of lateral spread. Mixed model analysis was applied to test each species for differences in treatment and provenance. First results e.g. for *A. pratensis* indicate significant differences between provenances in the number of hypogeogenous rhizomes while treatment had no significant effect on this plant functional trait. Further results will be presented.



## Ecosystem research regarding climate adaptation

Andreas Gohlke<sup>1</sup>, *Camilla Wellstein*<sup>1</sup>, Carl Beierkuhnlein<sup>1</sup>, FORKAST Consortium<sup>2</sup>

<sup>1</sup> Biogeography, University of Bayreuth

<sup>2</sup> Bavarian Research Cooperation "Impact of climate on ecosystems and climatic adaptation strategies"

Repercussions from changes in the global climate are increasingly manifesting themselves in terms of the regional sphere. Ecological repercussions in all their dimensions are still not completely visible to date, hence there exists such a sense of urgency regarding solutions for the challenges we are facing in climate and ecological systems research. Forests, grasslands and lakes are ecological systems with longevity, thus causing to be considerably impacted by future climate changes. In the light of current climate changes, the probability is steadily increasing that seldomseen and extreme climatological events will occur more often and with rising intensity. Moreover, novel forms of extreme conditions can be expected. There are climate researchers involved at the research cooperation FORKAST from 19 chairs and faculties at the universities of Bayreuth, Regensburg, Würzburg, Erlangen-Nuremberg as well as the Technical University of Munich. They make thorough investigations in reference to the following central issues: How do extreme climatic conditions (e.g. drought and very heavy rains) affect the characteristics of ecological systems and functions? How are ecological processes, such as the production of biomass or the interaction between animals and plants, affected? How resilient are our ecological systems? Research results in this matter are essential prerequisites in order to evaluate how ecological services (e.g. stability of mountain slopes, agricultural and silvicultural production) will be affected.



## SESSION 11 - ANIMAL EVOLUTION AND SURVIVAL

CONVENOR: OLIVER MARTIN

### ORAL PRESENTATIONS:

#### **Field preference and diet of foraging skylarks in winter**

*Flavia Geiger*<sup>1</sup>, Maurits Gleichman<sup>1</sup>, Heiner Flinks<sup>2</sup>, Geert R. de Snoo<sup>1,3</sup>, Frank Berendse<sup>1</sup>, Arne Hegemann<sup>4</sup>, B. Irene Tieleman<sup>4</sup>

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Populations of skylarks (*Alauda arvensis*) have declined with more than 60% between 1990 and 2007 in the Netherlands and show similar negative trends in other western and northern European countries. These trends are driven by both reduced reproduction success and adult survival in winter. Yet, in winter, little is known about habitat selection by foraging skylarks in Dutch agricultural landscapes. Between November 2008 and March 2009, skylarks were mapped within ten agricultural areas located in the northeast of the Netherlands. The survey areas comprised different arable fields and permanent grasslands. Food availability (flying insects, ground-dwelling arthropods, weeds and weed seeds) was sampled in six replicates of each of the following field types: former potato fields, former maize fields, cereal stubbles, and permanent grasslands. Skylark faeces were collected at foraging sites and the content of the faeces was analyzed. In the course of the winter, more than 2,000 skylarks were observed. Highest abundances were found on cereal stubble fields and to a lesser extent on former potato fields. Influences of food availability, field and landscape characteristics on the field preference of skylarks were investigated. Relations between skylark diet, based on the analysis of faeces, food availability and foraging habitat will be discussed.



**Sexual segregation and inter-annual flexibility in the foraging ecology of Imperial shags***Petra Quillfeldt*<sup>1</sup>, Juan Masello<sup>1</sup><sup>1</sup> Vogelwarte Radolfzell, Max-Planck-Institut für Ornithologie

Species of the blue-eyed shag complex are known as main benthic predators in subantarctic coastal habitats. Imperial shags (*Phalacrocorax atriceps albiventer*) mainly feed on benthic, slow-growing fish. As this is a depletable resource, pair partners should reduce competition by sexual segregation. We here present data on ecological segregation in foraging time, spatial use and diving behaviour of chick-provisioning male and female Imperial shags at New Island, Falkland Islands, over three breeding seasons. We further investigate how males and females adapt their foraging behaviour to differences in food availability among years. We found that females were restricted to coastal habitat and mainly benthic diving in all years. In contrast, males were more flexible, using benthic as well as pelagic foraging behaviour. Our results suggest that under favourable conditions, males but not females in this species can reduce energetically expensive behaviour.



**Ecological speciation over small scales– New insights from a field study on *Microcebus griseorufus* (Cheirogaleidae) in southwestern Madagascar**

Peggy Giertz<sup>1</sup>, Rakotomalala Yedidya Ratovonamana<sup>2</sup>, Thomas Püttker<sup>3</sup>

<sup>1</sup> Animal Ecology and Conservation, University of Hamburg

<sup>2</sup> Department of Plant Biology and Ecology, University of Antananarivo

<sup>3</sup> Leibniz Institute for Zoo and Wildlife Research, Evolutionary Genetics, Berlin

Madagascar is a biodiversity hotspot. Reasons for the extensive radiation of some taxa are still being discussed. Recent models postulate allopatric speciation during habitat shifts throughout climatic changes. While patterns of species distributions support this hypothesis, the mechanisms and initial processes of speciation are poorly understood. Mouse lemurs (*Microcebus*) show a remarkable species diversity. Most species are distributed over distinct environments. Therefore, they are a suitable model to investigate speciation questions from an ecological perspective. We conducted a mark-recapture study of *M. griseorufus* in Madagascar. We covered along 2.5 km different vegetation formations. Edaphic conditions resulted in a “sandwich” situation with two mesic habitats on either side of an arid habitat. We compared population dynamics using logistic regression and AIC. Model parameters were survival, birth and population growth rate. Model selection showed that survival varied between vegetation formations whereas birth and population growth rate did not differ. We suppose that the three populations are linked in a source sink situation. However, habitat fidelity of mouse lemurs is high. Distinct differences in food availability and microclimate may select for different traits in either habitat. We discuss the diversification potential of this situation and infer ecological speciation to be a main driver of the mouse lemur radiation. Supported by DFG Ga 342/15-1 and WWF Germany



**Axial skeleton defects in *Rutilus rutilus* (Teleostei: Cyprinidae) exposed to radiation contamination in the area of the Eastern-Urals Radioactive Trace**

*Nina Bogutskaya*<sup>1</sup>, Alexander Naseka<sup>1</sup>, Mikhail Zuykov<sup>2</sup>

<sup>1</sup> Laboratory of Ichthyology, Zoological Institute, Russian Academy of Sciences

<sup>2</sup> V.G. Khlopin Radium Institute

The present study contributes to the knowledge of the osteological abnormalities in fish due to radioactive contamination. It was designed to describe the occurrence of axial skeletal malformations in common roach, *Rutilus rutilus*, from an area under presumed radiation contamination. Abnormal specimens were collected in water bodies of the Techa Cascade of Reservoirs (Chelyabinsk Province, Russia) located in the area of the Eastern-Urals Radioactive Trace. A high number of malformations were detected, both in the unpaired fin and the vertebral column including the caudal complex. The abnormalities were extra-numerous elements, fusions, deformities and displacements of the elements. A big number of individuals, 94.1 and 97.2% in two samples studied, showed at least one anomaly, and the highest occurrence of abnormalities was observed in the caudal region. We identified classes, categories and types of axial skeleton abnormalities most of which are considered as minor, such as doubling of arches and spines, and shortening or deformation of the latter. Only few major defects were found. The causes of malformations were not identified but the high incidence of anomalies may be attributed to either direct or indirect effects of radiation contamination that affect skeletal development. The results show that the detection of axial skelet abnormalities in fish can be an indicator of unfavourable environmental conditions in areas impacted by contamination and pollution.



**A matter of habitat size? Genetic erosion in a stenotopic heathland ground beetle (Coleoptera: Carabidae)**

*Claudia Drees*<sup>1</sup>, *Andrea Matern*<sup>2</sup>, *Thorsten Assmann*<sup>2</sup>

<sup>1</sup> Department of Zoology, Tel Aviv University

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Two centuries ago large areas of north-west Europe were covered by coherent heathlands which hosted numerous specialized species. Changes in land use made heathlands fragmented and rare, consequently, they are in the focus of nature conservation efforts today. But how large should remaining heathland patches be in order to secure the survival of populations of specialized species?

We investigated the genetic diversity at five allozyme loci of *Poecilus lepidus*, a flightless and stenotopic heathland ground beetle. 29 populations from differently sized heathland patches in north-west Germany were analyzed. Results show a weak but significant genetic differentiation and no evidence for isolation by distance or other patterns of spatial autocorrelation. Linear regression analysis revealed significant relationships between patch size, allelic richness, number of alleles and expected heterozygosity. These findings are explained by severe habitat fragmentation together with strong fluctuations in population size which have been reported for this species in the past. To conserve the vast majority of the species' genetic diversity for a period of 100 years we suggest to maintain heathland patches of at least 50 ha in size.



POSTER PRESENTATIONS:**Early gonado- and gametogenesis in juvenile protogenous hermaphrodites: A case study of two European lampreys (*Lethenteron ninae* and *Lampetra fluviatilis*)**

Marina Mosyagina<sup>1</sup>, Alexander Naseka<sup>2</sup>, Nina Bogutskaya<sup>2</sup>, Andrey Shil'dyaev<sup>1</sup>, Sako Tuniev<sup>3</sup>

<sup>1</sup> Faculty of Biology and Soil, St. Petersburg State University

<sup>2</sup> Laboratory of Ichthyology, Zoological Institute, Russian Academy of Sciences

<sup>3</sup> Sochi National Park

A comparison of the reproductive system in parasitic and non-parasitic lampreys is of great evolutionary and ecological interest. We compared gonadal development in Transcaucasian brook lamprey *Lethenteron ninae*, European river lamprey *Lampetra fluviatilis*, and salmon of three species of the genus *Oncorhynchus* (project RFBR 09-04-01584). The histological examination revealed that both lampreys are juvenile protogenous hermaphrodites, similar to *Oncorhynchus*, for all males go through a juvenile ovary stage. In resident non-parasitic *L. ninae* the main stages of gonadal development start at a larger size than in the migratory parasitic *L. fluviatilis*. Females of *L. ninae* lack a reserve fund of germ cells since they are 65 mm long while in *L. fluviatilis* few gonial and previtellogenous oocytes remain until the very metamorphosis similar to that in *Oncorhynchus* salmon. Besides, the testes of the Caucasian brook lamprey contain some previtellogenous oocytes and complexes of meiocytes until the fishes attain 102 mm TL while in males of *L. fluviatilis* starting from 61 mm there are no feminine germ cells at all. The differences found may be attributed to their different modes of life, residential and migratory. The obtained data support the hypothesis that the semelparity of lampreys has been evolutionary preceded by a form of repeat spawning. Evolutionary trends of the lampreys and salmon of the genus *Oncorhynchus*, both being monocyclic animals, are discussed.



**Soil susceptibility to black locust (*Robinia pseudoacacia*) invasion outside woodland in agricultural landscape**

Danijel Ivajnsic<sup>1</sup>, Mitja Kaligaric<sup>1</sup>

<sup>1</sup> Department of biology, Faculty of natural science and mathematic/University of Maribor

In this study we aimed to detect the invasiveness of black locust relation to the susceptibility of different soil and habitat types to invasion. The research was performed in the model traditional agricultural landscape of Goričko Landscape Park (Slovenia). 1307 polygons belonging to 28 different habitat types (following PHYSIS typology), aggregated to 11 types, are evidently invaded by locust and cover 0.6% of the total area of the park or 0.83 % of the non-forested share of the park. 993 polygons are pure stands of black locust with an average area of almost 2000 m<sup>2</sup>. Locust is also present in small woodlots and in lowland and collinear riverine willow scrub. In other habitat types black locust is present in less than 30 polygons. The elongation index has the highest value in pure locust stands, followed by small woodlots and willow scrub. It is confirmed that most of the polygons with black locust are linear in form, representing the edges of fields, orchards and grasslands. The most frequently invaded soils are pseudo-gley, where pure locust stands cover more than 800,000 m<sup>2</sup>. Riverbank soils are in second place, while other types of soil invaded by locust include district brown soil, eutric brown soil and – surprisingly – hypogley. It can be concluded that fresh and water-retaining soils are the most favorable for locust invasion.



**DNA barcoding as a method for species identification in the hyperdiverse ant genus *Pheidole***

Rossa Ng'endo<sup>1</sup>, Jochen Bihn<sup>1</sup>, Roland Brandl<sup>1</sup>

<sup>1</sup> Department of Ecology—Animal Ecology, Faculty of Biology, University of Marburg, Marburg, Germany

DNA barcoding is increasingly being used to assist in the identification of nominal species and morphospecies. We utilized sequences of the mtDNA *cox1* gene measuring 636 base pairs long, from 47 *Pheidole* ants collected in the Brazilian Atlantic Forest to establish whether the morphology-based assignment of individuals into species is supported by DNA-based species delimitation. We found that 15 out of 19 DNA-based clusters (Molecular Operational Taxonomic Unit(s); MOTU), allocated using sequence divergence thresholds of 2 % and 3 %, matched with the 20 species determined using morphological characters. Both thresholds yielded the same number of MOTUs. The average pairwise sequence divergence for all 47 sequences was 19.4 %, ranging between 0-25.3%. In some cases morphology and molecular based methods differed in their assignment of individuals to species or morphospecies based on a threshold between 2 and 3 %. The occurrence of distinct mitochondrial lineages within morphological species highlight groups for further detailed genetic and morphological studies.



**Elevated environmental temperature alters the balance between costs and benefits of reproduction***Oliver Martin*<sup>1</sup>, Vera Grazer<sup>1</sup><sup>1</sup>Institut f. Integrative Biologie, ETH Zürich

Sexual conflict occurs because evolutionary interests diverge between the sexes, potentially leading to sexually antagonistic coevolution. Fitness costs and benefits of multiple mating are generally not incurred equally by males and females and this may exacerbate conflicts. The balance between costs and benefits will affect not only individual, but also population fitness. It is highly likely that this balance is sensitive to environmental conditions with ongoing changes causing disturbances. However, biodiversity is currently being challenged by major climate changes including global warming yet empirical data is scarce. A better understanding of environmental effects on sexual reproduction and population fitness is crucial. Here we assess female fitness under monogamous and polyandrous conditions at normal temperature *versus* elevated temperature. We found a substantial survival cost of reproduction at normal temperature, yet no cost at elevated temperature. Total reproductive success was similar across mating treatments at normal temperature. In contrast, at elevated temperature we detected a significant benefit of polyandry compared to monogamous mating. These results indicate that the cost-benefit balance of reproduction can be changed profoundly by environmental factors such as temperature with considerable consequences for population fitness. These findings are not only significant for the study of sexual selection, but also advance our understanding of consequences of climate change for population fitness.



**Do carabids follow Bergmann's rule? A macroecological study on ground beetles in the Western Palaearctic (Coleoptera: Carabidae)**

*Katharina Schäfer*<sup>1</sup>, *Andreas Schuldt*<sup>1</sup>, *Claudia Drees*<sup>2</sup>, *Thorsten Assmann*<sup>1</sup>

<sup>1</sup> Leuphana University Lüneburg, Institute of Ecology and Environmental Chemistry

<sup>2</sup> Tel Aviv University, George S. Wise Faculty of Life Sciences, Department of Zoology

Although Bergmann's rule was once established for endotherms, several modern-day macroecological studies detected clear latitudinal gradients in body size of ectotherms as well – both at the intra- and at the interspecific level. Considering the species-rich invertebrate taxon of ground beetles in the western Palaearctic, regression models showed significant relationships of body size with spatial, topographic and climatic variables. Carabid body size increased from Northern Europe southwards and then decreased towards North Africa. A similar latitudinal pattern is known from the species richness of ground beetles. Whereas geographic variation in body size tends to be influenced by contemporary climatic parameters (especially temperature variables), another trait of carabid species, genetically determined hind wing development (which is directly linked to different powers of dispersal), seems to be biased by historical climatic events (represented by topographic variables). Distinct differences between regression models for endemic (restricted-range) and widespread carabid species likewise indicate historical processes (e.g. postglacial colonization) and the present-day climate as important factors in the interpretation of the detected patterns.



## SESSION 12 - THE FUTURE OF POLLINATION SERVICES: PERSPECTIVES ON CONSERVATION ACTIONS

CONVENOR: FRANK JAUKER, CATRIN WESTPHAL

### ORAL PRESENTATIONS:

#### **Introducing the pollinator session and an attempt to disentangle functional responses of pollinators to mass flowering crops**

Frank Jauker<sup>1</sup>, Franziska Peter<sup>1</sup>, Volkmar Wolters<sup>1</sup>, Tim Diekötter<sup>1</sup>

<sup>1</sup>Department of Animal Ecology, Justus Liebig University Giessen

Potential benefits of mass-flowering crops to pollinators due to their ample provision of nectar and pollen have been intensively discussed recently. For bumblebees, an increased early colony growth mediated by oilseed rape did not translate into improved sexual reproduction later in the season. For solitary bees, however, reproductive success might respond much more directly to the highly rewarding but shortly flowering crop because of the simultaneous production of propagable male and female offspring. In our study using trap-nests in 12 agricultural sites in central Germany differing in the amount of oilseed rape in the surrounding landscape, the number of nests of *Osmia rufa* increased with increasing area of semi-natural habitats and the mean number of brood cells increased with increasing area of oilseed rape. The absolute number of bees emerging the next year was positively affected by the area percentage of semi-natural habitats only. Despite its positive influence on the reproductive investment measured as the number of cells per nest, the area of oilseed rape had no effect on the number of emerging bees in the next generation. This pattern seems similar to the reported positive effect of mass flowering oilseed rape on colony growth of bumble bees that also failed to translate into sexual reproduction. In contrast to oilseed rape, the area of semi-natural habitats translated into a higher number of emerging *O. rufa* in the next generation.



## **Spatial resolution of spillover effects by pollinators and herbivores from oilseed rape fields into the agricultural landscape**

Christian Schellhorn<sup>1</sup>, Tim Diekötter<sup>1</sup>, Florian Vorwalder<sup>1</sup>, Volkmar Wolters<sup>1</sup>

<sup>1</sup> Department of Animal Ecology, Justus Liebig University Giessen

Mass flowering oilseed rape constitutes a resource pulse for many organisms in agricultural landscapes. Yet, after mass flowering has ceased built up populations of organisms they need to find alternative resources in the surrounding. Here, we were interested how far this spillover of pollinators and herbivores from wilted oilseed rape fields reaches into the surrounding landscape. Therefore, we selected three small and three large isolated oilseed rape fields with one side bordered by a forest edge. We used mechanical induced and non-induced wild mustard plants (*Sinapis arvensis*) as phytometers that were placed in distances of 0m, 250m and 500m from the field parallel to the forest. We expected a size: distance interaction in the abundance of pollinators and herbivores on phytometer plants and a clear preference for non-induced wild mustard plants. Pollen beetles (*Meligethes aeneus*) and sawflies (*Symphyla*) showed significant spillover effects. Contrasting our expectation, however, spillover of *M. aeneus* was stronger at all distances from small than large fields suggesting thinning effects in large fields. Pollination was highest at 500m and lowest at 0m and there were no differences in abundance and yield parameters between induced and non-induced plants. We conclude that the spillover of insects from oilseed rape after mass flowering may lead to shifts in community composition and the associated functions and services in surrounding habitats.



## **Pollen dispersal in grasslands: Facilitation or competition at high plant species diversity?**

Lena Kloss<sup>1</sup>, Walter Durka<sup>1</sup>

<sup>1</sup> Community Ecology, Helmholtz Centre for Environmental Research – UFZ

Many flowering plants depend on pollinators for gene flow. The attractiveness of a plant community to pollinators depends on the identity, density and diversity of species. We investigate whether a high diversity of co-flowering plant species leads to facilitation of or competition for pollination. Furthermore, we ask if plant species differing in their pollination specialisation are affected differently. We set up an experiment along a gradient of species diversity on 14 managed grassland sites within the Biodiversity Exploratory Hainich. We used two plant species, one with a generalised pollination syndrome (*Raphanus sativus*) and the other being rather specialised (*Lychnis flos-cuculi*). Fifteen plants of each species were situated at five defined distances along 50m-transects and were freely pollinated over 8 weeks. We assessed pollinator service as seeds per flower and as pollen dispersal distance. We genotyped the mother plants and their offspring in order to identify the pollen donor of each seed, to calculate the pollen dispersal distances. While seed set of *L. flos-cuculi* decreased with increasing species richness, we found no relationship in *R. sativus*. Pollen dispersal distance was negatively affected by species diversity. Both patterns of decreased pollination service indicate that at high plant species diversity competition for pollination prevails over facilitation. Less dense populations of plants specialised on few pollinators seem to be more vulnerable to this competition.



**Effects of population size on pollinator guild, reproductive success, and long term sustainability of *Comarum palustre* (Rosaceae)**

Laurent Somme<sup>1</sup>, Carolin Mayer<sup>1</sup>, Anne-Laure Jacquemart<sup>1</sup>

<sup>1</sup> ELI (Earth and Life Institute), UCL - Louvain-la-Neuve

The great majority of flowering plants in temperate regions depend on insects for pollination and reproductive success. Habitat fragmentation resulting in small and isolated plant populations are major threats to plant-pollinator networks. Remnant populations are affected by demographical, genetic and environmental stochasticity leading to genetic erosion. This threatens the ability of populations to respond to altering selection pressures such as climate change. *Comarum palustre* is a perennial herb growing in highly fragmented bogs in the Ardennes in Belgium. We investigated whether population size influences its reproductive success. Flower observations, pollen limitation experiments and pollen dispersal measures with fluorescent dye were conducted in small and large populations of *C. palustre* from 2008 to 2010. Significantly more insects were visiting *C. palustre* in large compared to small populations in the two flowering seasons analysed so far (2008 and 2009). Still, this does not seem to have an influence on its reproductive success since the species did not suffer from pollen limitation. Fluorescent dye imitating pollen flow was dispersed over the whole population size (up to 200m) in three of the four investigated study sites. Observed differences in the fourth site maybe explained by the height and density of the surrounding vegetation. Dye dispersal patterns will further be related to population genetic structure.



## **The impact of *Heracleum mantegazzianum* on plant-pollinator interactions – Bully or gentle giant?**

Ulrich Zunkler<sup>1</sup>, Manfred Kraemer

<sup>1</sup> Biologische Sammlung, Universität Bielefeld

*Heracleum mantegazzianum* is one of the most ill-famed invasive species in Europe. Its large compound umbels are highly attractive to a broad range of flower visiting insects. Aim of this study was to scrutinize the impact of the invader on native plant-pollinator interactions. A field survey and measurements of pollinator efficiency were conducted for the alien *H. mantegazzianum* and the native plant *H. sphondylium*, which has a similar flowering phenology and morphology. The most common visitor and most important pollinator for *H. mantegazzianum* is the honeybee (*Apis mellifera*). This is in contrast to the native plant, where a group of equally important insects acted as pollinators and hardly any visits from honeybees occurred. While a low similarity of the pollinators makes competition effects between these two plant species unlikely, effects mediated by honeybees might even have further impact on other native plant species, which rely on this generalistic pollinator. This aspect was examined in an experimental garden setup. Results show, that *H. mantegazzianum* was well integrated in plant-pollinator networks. Moreover, plant-animal networks of plots with and without the invader showed low similarity. However, overall insect visitation of native plants in networks, where the invader was present was enhanced and seed set remained unaffected. The invader has, in this context, no negative effect on native plants and seems to be a valuable resource for flower visiting insects.



## **Insect diversity and pollination of *Celtis africana* in human modified South African scarp forests**

*Eike Lena Neuschulz<sup>1</sup>, Ingo Grass<sup>1</sup>, Nina Farwig<sup>1</sup>*

<sup>1</sup> Conservation Ecology, University of Marburg

Human disturbance is a major threat to forest ecosystems modifying species diversity and ecological processes. Insects are supposed to be highly susceptible to human disturbance which may affect pollination services and finally, the persistence of plant populations. We investigated overall insect diversity and pollination of the native tree species *Celtis africana* in indigenous scarp forests in a heterogeneous South African landscape. We chose six representative types of forest modification, influenced by different intensities of human disturbance: continuous natural forests in nature reserves, natural forest fragments in nature reserves, forest fragments in plantations, forest fragments in agricultural matrix, forest gardens and secondary forests in game reserves. Rarefied insect richness differed significantly among forest types, with most insect species recorded in forest gardens and secondary forests. Similarly, pollinator visitation rates of *Celtis africana* were highest in the four most intensively disturbed forest types, and low in natural fragments and continuous forests. Differences in visitation rates could be explained by high abundances of honey bees in disturbed forests. Our results indicate that insect richness and pollination were enhanced in the most intensively disturbed forest types. Further analysis on species' functional traits will clarify the causes underlying the observed relationship between insect richness and pollination.



## Win some, loose some – Pollinator shifts in a fragmented habitat?

Nils Hasenbein<sup>1</sup>, Manfred Kraemer<sup>1</sup>

<sup>1</sup> Biologische Sammlung, Universität Bielefeld

It has been shown that fragmentation of ecosystems affects various ecosystem processes. A decrease of genetic exchange may facilitate a loss of biodiversity in disturbed habitats. Reproduction in isolated populations is potentially limited due to a lack of genetic exchange between plants, resulting from reduced pollinator visitation rates, reduced pollen load of pollinating animals, and low quality of available pollen. Moreover, pollinators potentially shift to similar and adequate species of the surrounding matrix, reducing visitation frequencies inside the fragments and changing the pollen composition of pollen loads

We investigated if forest fragmentation affects the pollination of *Acanthus eminens* (Acanthaceae), a shrub growing in Kakamega Forest in Western Kenya, which is affected by anthropogenic disturbance and fragmentation. *A. eminens* main pollinators are carpenter bees (*Xylocopa*). We will present data which show that there is pollinator limitation, and a sharing of pollinators with the closely related *Acanthus polystachius*, a common plant of the surrounding farmland. Our presentation includes an analysis whether the species compete for pollinators, and to what extent interspecific pollen transfer affects the reproduction of *A. eminens*. We take into account not only the decline of ecosystem processes caused by fragmentation, but also the effects of new processes being facilitated by fragmentation, which have rarely been included in studies on fragmentation.



## **Finding communities in weighted pollination networks**

*Carsten Dormann*<sup>1</sup>, Rouven Strauß<sup>1</sup>

<sup>1</sup>Computational Landscape Ecology, Helmholtz Centre for Environmental Research – UFZ

Many algorithms have been proposed in order to detect community structure in networks. However, no algorithm for identifying modules in explicitly bipartite weighted graphs has been proposed to date. In order to apply the existing algorithms to weighted networks, it is common practice to neglect the additional information provided by the edge weights by projecting the quantitative network onto the corresponding binary network. Here we introduce a new algorithm for weighted, bipartite networks, and apply it to various pollination networks. The resulting communities are ecologically informative and group known pollination syndromes. Our approach can be similarly applied to other network types.



## One hundred key questions for pollination ecology

*Carolyn Mayer*<sup>1</sup>, *Lynn Adler*<sup>2</sup>, *Scott Armbruster*<sup>3</sup>, *Amots Dafni*<sup>4</sup>, *Connal Eardley*<sup>5</sup>, *Shuang-Quan Huang*<sup>6</sup>, *Peter Kevan*<sup>7</sup>, *Jeff Ollerton*<sup>8</sup>, *Laurence Packer*<sup>9</sup>, *Simon Potts*<sup>10</sup>, *Axel Ssyman*<sup>11</sup>, *Jane Stout*<sup>12</sup>

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<sup>3</sup> University of Alaska, USA

<sup>4</sup> University of Haifa, Israel

<sup>5</sup> Plant Protection Research Institute, South Africa

<sup>6</sup> Wuhan University, China

<sup>7</sup> University of Guelph, Canada

<sup>8</sup> University of Northampton, UK

<sup>9</sup> York University, Canada

<sup>10</sup> University of Reading, UK

<sup>11</sup> Bundesamt für Naturschutz, Germany

<sup>12</sup> University of Dublin, Ireland

To inspire future research on pollination ecology, strengthen the links between science and nature conservation, and to attract interest from stakeholders, we would like to highlight the 100 most important questions for pollination ecology. The aim is to identify gaps, new directions for research, and the priorities for pollinator and plant conservation. Previous ‘brainstorms’ have been highly successful in informing researchers and decision makers (e.g. Sutherland et al. 2009 One Hundred Questions of Importance to the Conservation of Global Biological Diversity), and we hope to inspire lively discussions not only from researchers but also from conservationists, politicians and funders. We conducted a poll among almost 200 recognised experts by asking them to express the most urgent issues for the discipline. More than 650 different questions were gathered within a short time. These were assigned to different categories such as conservation, taxonomy, methodology, management, etc.; duplications were deleted or merged. Further, questions were synthesized for each category to reflect the main domains. We then voted for the remaining questions and the ultimate ranking produced the final 100 key questions. A summary of our findings will be presented while full results will be published in the newly launched, peer-reviewed, open access ‘Journal of pollination ecology’ (JPE, [www.pollinationecology.org](http://www.pollinationecology.org)).



POSTER PRESENTATIONS:**Growing crops for bioenergy: The impact on plant-pollinator communities**

Dara Stanley<sup>1</sup>, Jane Stout<sup>1</sup>

<sup>1</sup> Botany Department, School of Natural Science, Trinity College Dublin

Pollinators are increasingly threatened by factors including land use change and agricultural intensification. A major shift in agricultural land use is imminent with the widespread cultivation of bioenergy crops as an alternative fuel source to combat climate change, with implications for biodiversity. This study focuses on the impact of two bioenergy crops – the annual, high input, flowering winter oilseed rape (*Brassica napus*) and perennial, low-input *Miscanthus giganteus*, on pollinators and pollination. We used diversity and abundance measures and plant-pollinator networks to examine the impacts of these contrasting energy crops, compared to the crops they replaced, at the community level in Ireland. Transect walks were used to quantify flower-visiting species and their interactions with flowering plants, and pan traps were used to measure pollinator abundance and diversity in 2009. Bipartite interaction networks were constructed for each site. The potential of mass flowering oilseed rape to influence pollen transfer to native plant species was also investigated through a pollen transfer network. Differences were found between energy crops and the crops they replace at both the species and community level. The findings are discussed in the context of ongoing impacts on pollination systems, with implications for farm management to combat pollinator decline. This project is part of the SIMBIOSYS project focusing on key sectors in Ireland and their affects on associated ecosystem services.



## **Density or spatial patterns of inflorescences – What influences the success of shared-pollination most?**

*Eva-Maria Hoch*<sup>1</sup>, Sven Hanoteaux<sup>1</sup>, Merav Seifan<sup>1</sup>, Katja Tielbörger<sup>1</sup>

<sup>1</sup> Plant Ecology Department, Institute of Evolution and Ecology, University of Tübingen

Many plant species depend on insect pollination for reproduction, thus depend on specific traits which enhance their attractiveness. However, since most species do not grow alone, the reproductive success depends not only on the species' ability to attract pollinators, but also on the neighboring species' traits. Although little is known about shared pollinators and the conditions governing them we can predict that a highly attractive species will increase visitation rate to its less attractive neighbors as long as the pollinators have no other options within their searching area. Therefore, the effect of pollinators is expected to be regulated by the attractive and non-attractive species' densities. Similarly, spatial aggregation of attractive species may keep pollinators within the patch, preventing them from visiting less attractive species. On the other hand, if the attractive species is well dispersed among the less attractive ones, it may attract more pollinators to the mixed patch. Here, we present first results of a field experiment manipulating density and spatial pattern of a potential attractive species, *Centaurea cyanus*. In the experiment we assessed the effect of the treatments on pollinator visits to neighboring species in semi-natural grasslands.



**Pollinators increase fruit quality of self-pollinating *Rosa canina***

Anikó Kovács<sup>1</sup>, Sebastian Hänke<sup>2</sup>, Péter Batáry<sup>2</sup>, Birgit Meyer<sup>3</sup>, András Báldi<sup>4</sup>, Teja Tschardtke<sup>2</sup>, Andrea Holzschuh<sup>5</sup>

<sup>1</sup> Faculty of Agriculture and Environmental Sciences, Szent István University, Gödöllő, Hungary

<sup>2</sup> Agroecology, Department of Crop Science, Georg-August University, Göttingen, Germany

<sup>3</sup> Department of Natural History, Hessisches Landesmuseum Darmstadt, Germany

<sup>4</sup> Animal Ecology Research Group, Hungarian Natural History Museum, Budapest, Hungary

<sup>5</sup> Department of Animal Ecology and Tropical Biology, University of Würzburg, Germany

*Rosa canina* is a facultatively self-pollinating species but pollinators might still influence its reproductive success. We investigated the effects of hedgerow-forest connectivity and adjacent crops, i.e. winter cereal and oilseed rape, on bee and hoverfly abundance and pollination success of *R. canina*. Twelve forest edges, hedges connected to forests and isolated hedgerows, respectively, were selected, half of them adjacent to winter cereal and half next to oilseed rape. Pollinator abundance on rose flowers was measured during one 15-minute-observation event after rape flowering. The effectiveness of insect pollination was measured by bagging two branches per plant before flowering to exclude pollinators. Fruit set, fruit mass, seed set and seed mass on the bagged branches were compared to fruits and seeds of previously marked open-pollinated branches. Forest-hedge connectivity had no effect on pollinators or pollination success. However, pollinators were more abundant in hedges with a higher amount of rose flowers and in hedges next to oilseed rape that provide vital resources in natural structures after mass flowering of rape. Pollinators did not increase fruit set or seed mass, but fruit mass and seed set were significantly higher at the open-pollinated branches. Hence, even though a facultative self-pollinating species such as *R. canina* is capable to initiate fruit set, pollinators can still enhance the quantity and quality of a plant's reproductive output.



## **Pollination ecology and breeding system of an understory herb in the Atlantic Rainforest of Brazil**

*Katharina Stein*<sup>1</sup>, Isabell Hensen<sup>1</sup>

<sup>1</sup> Dpt. of Plant Ecology, University of Halle

Despite tropical understory flora contributes 20 - 50% to the local diversity of vascular plants, particularly their functional relation with the environment is largely unknown. Out crossing and sexual reproduction of many plants depend on pollinators which provide an essential ecosystem service to maintain overall biological diversity of natural ecosystems. Especially in the tropics, due to high animal and plant diversity and thus a huge amount of niches, there exist highly specific pollinator-plant-relationships. *Besleria melancholica* (Vell.) C.V. Morton (Gesneriaceae) is an endemic understory herb of the Atlantic Rainforest in the state of Rio de Janeiro in Brazil. It is common in the understory of pluvial forests in shady habitats near slopes and waysides. Pollination ecology, breeding system and female reproductive output of this species in natural habitat has been investigated. The preliminary results show the absence of pollen limitation and an obvious dependency on pollinators for *B. melancholica*. Despite the melittophilous flowering syndrome of this species, hummingbirds seem to play a more important role as pollinators than bees.



**Organic dairy farming: Impacts on insect-flower interaction networks, flower-visitor assemblages and pollination services***Eileen Power*<sup>1</sup>, Jane Stout<sup>1</sup><sup>1</sup> natural sciences, Trinity College Dublin

Characterising insect-flower interaction networks provides new insights into the stability of pollination systems. Though intensive grassland systems are widespread, it is unknown how pollination network size and structure can be affected by management intensification and whether organic farming can mitigate negative effects (as in arable systems). It is also unclear, for intensive grasslands, how farming system affects insect-visitor abundance/richness/evenness and pollination services. We investigated the effects of organic versus conventional farming on insect-flower interaction network size and structure; bee and hoverfly abundance, richness and evenness and pollination services in 10 pairs of organic and conventional dairy farms in the Republic of Ireland. We found that organic insect-flower interaction networks were significantly different to conventional networks in terms of certain network parameters and containing more multiple-linked insect species and more plant species. There were higher bee abundances (correlated with increased floral resources) in organic fields. Hoverfly evenness was greater in organic farms but hoverflies were not related to floral resources suggesting that organic farms provide other resources for hoverflies. There were increased pollination services to *Crataegus monogyna* on organic farms, but pollen was not limited in either system. Results are discussed in terms of the value of organic dairy farming to the conservation of pollination systems.



## SESSION 13 - BIOTIC INTERACTIONS ON VARIOUS TROPHIC LEVELS

CONVENOR: ANNA TREYDTE, KATJA GEIßLER

### ORAL PRESENTATIONS:

#### **Linking physiological based individual plant performance to community dynamics: Analysing the importance of stress and interactions for succession and coexistence of species rich communities**

*Kristin Bohn*<sup>1</sup>, Björn Reineking<sup>2</sup>, James Dyke<sup>1</sup>, Ryan Pavlick<sup>1</sup>, Björn Reu<sup>1</sup>, Axel Kleidon<sup>1</sup>

<sup>1</sup> MPI Biogeochemistry

<sup>2</sup> University Bayreuth

Individual plant performance influences how species interact and thus shapes compositional dynamics (e.g. succession, coexistence). Our aim is to understand community composition from species interactions and abiotic stress.

We develop a simple model that simulates compositional dynamics of plant communities. The model reproduces dynamics of diverse communities such as succession. Species interact through seedflux and competition for space. In our model the importance of both types of interactions can be varied gradually as well as stress.

The model relates species ecophysiological properties to spatial dynamics and interactions. Our sensitivity study highlights the importance of interactions between species and abiotic stress for community dynamics. In order to incorporate diverse community dynamics in vegetation models these sensitivities are of crucial importance.



**N-transfer between grassland species: effects of community composition, species identity and simulated grazing**

Lea L.A. Martin<sup>1</sup>, Uwe Rascher<sup>1</sup>, Ulrich Schurr<sup>1</sup>, Vicky M. Temperton<sup>1</sup>

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Biodiversity field studies revealed positive effects of species richness on productivity and resource use efficiency but detailed information about interaction processes are rare. We performed a <sup>15</sup>N-tracer microcosm (MC) study to investigate N-dynamics between individuals in differently composed communities. We test how species richness and identity (a mesic grassland grass, forb and legume species) affect N-dynamics and if it is possible to simulate field-effects within MC. We treated half of the MC with “simulated grazing” to test how grazing affects plant-plant interactions. Higher species richness, but not legume presence, increased short-term N-transfer from <sup>15</sup>N-labelled donor to non-labelled receiver individuals. Legume presence increased receivers’ productivity (DW) and nitrogen use efficiency (NUE). Results indicate N-facilitation by N-sparing but also short-term N-transfer. Species identity affected interactions significantly: the grass profited more from a legume donor (↑DW+NUE) than the forb, confirming a superior N-acquisition strategy of grasses, as has been found in field studies. Simulated grazing increased N-transfer in monocultures but decreased it in mixtures. We were able to reproduce field-effects; short-term MC studies are thus useful to investigate and predict early-successional plant-plant interactions in grassland habitats. Effects of simulated grazing on N-dynamics were unexpected and are worth further investigations for plant behaviour research.



### **Are silica defences in grasses driving vole population cycles?**

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Field vole population cycles are traditionally thought to result from their interactions with specialist predators, whereas food quality is not thought to respond to herbivory in a way which could lead to cycles. However, it is known that periods of sustained heavy grazing increase silica concentrations in grass leaves, and more recent greenhouse studies showed foliage digestibility and nitrogen absorption by field voles to be reduced when feeding on high silica plants, resulting in reduced vole growth rates. We are testing the hypothesis that herbivory induced silica-based defences are driving field vole population cycles. We have carried out large-scale field manipulations of vole densities and measurements of grass silica concentrations in an upland grassland ecosystem to test the relationship between plant defence and vole population fluctuations in this system.



**Mammalian herbivory affecting Acacia trees and symbiotic ants in an African savanna**Franziska Bucher<sup>1</sup>, Anna Treydte<sup>1</sup>, Lauren McGeoch<sup>2</sup>, Truman Young<sup>2</sup><sup>1</sup> Agroecology in the Tropics and Subtropics, Hohenheim University<sup>2</sup> University of California, Davis

Cattle and livestock herbivory change surrounding vegetation and animal species in various ways. In east African savannas grass-dominated glades mark patches where cattle were herded at night. The vegetation surrounding glades is usually dominated by a dense ring of trees, mainly *Acacia drepanolobium*, which are inhabited by symbiotic ant species defending the tree against mammalian herbivores. We tested whether the presence of different domestic and wild herbivores led to shifts in vegetation structure and associated ant communities in and around glades. We established transects radiating away from glades within enclosure plots allowing selectively the presence of livestock, wildlife, mega-herbivores or no herbivores in Laikipia, Kenya. We assessed woody vegetation structure, relative abundance of mammalian herbivore species using dung counts, and ant species presence on *A. drepanolobium*. We found that, after ten years of fencing, few trees grew on glades, even when browsers were excluded. Zebra and cattle dung was more frequently found in than further away from glades, and zebra were less common in areas where livestock were present, indicating feeding competition. The ant species *Crematogaster sjostedti* was twice as often and *C. mimosae* least often found in wildlife plots compared to other herbivore treatments. Hence, livestock herbivory affects both vegetation structure and associated insect fauna differently than wildlife herbivory.



**Multitrophic cascading effects of experimental changes in plant diversity on nesting bees, wasps, and their parasitoids**

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Plant diversity changes are often assumed to have serious impacts on density, diversity and ecosystem functioning of species at higher trophic levels. We used an experimental gradient of grassland plant diversity ranging from 1 to 16 plant species to study the multitrophic interactions among plants, cavity-nesting bees and wasps, and their natural enemies. We analysed community similarity, diversity (species richness) and brood cell density of cavity-nesting bees, wasps and their parasitoids over two consecutive years. The bee and wasp communities were more similar among the high (16 species) diversity plots than among plots of the lower diversity levels (up to eight species), and a more similar community of bees and wasps resulted in a more similar community of their parasitoids. Increasing flower diversity, which was closely related to the diversity of all plants, led to higher brood cell density of bee pollinators and wasp predators and associated higher bee and wasp diversity. A more diverse bee and wasp host community attracted a higher number of parasitoid species. Parasitism rates of bees were related to the diversity of bee parasitoids, mediated by changes in flower diversity. In conclusion, plant species loss propagated through different trophic levels: from plants to host insects (bees, wasps) to their parasitoids, decreasing density, diversity and community similarity. The positive effect of plant diversity on the community similarity of hosts indicates a community stabilising effect of high plant diversity.



**Allometric functional responses constrain consumption preferences of epigeic arthropod predators**

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One of the great striking questions in ecology remains whether insights that we get from simplified laboratory experiments may help us to predict the outcome of species interactions in a world of almost infinite complexity. We addressed this problem applying the functional response framework, where the per capita consumption rates of predators depend on prey density. First, we determined functional responses of five epigeic arthropod predators on a large and a small prey, respectively, in simplified single-prey trials resulting in 10 different functional responses. Secondly, the parameters derived from these single-prey experiments were used to predict feeding rates applying an extended multi-species functional response model and in the last step those predictions were tested in two-prey experiments. In general we found preferences for the larger prey for all predators tested. While most of them were in accordance with the predictions of single-prey experiments - resulting in a passive preference – we also found active preference for the larger prey in one out of five predators. Our results suggest that simple single-prey experiments may be sufficient to predict the outcome of more complex interactions when additional information about body sizes of predator and prey are available.



**The performance of a generalist herbivore in a diverse world –Plant species richness, composition and quality matter**

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Generalist insect herbivores can occur in habitats differing in food plant species richness and composition. In contrast to specialists, the effect of differences in food plant availability and food plant species richness among habitats have rarely been studied in generalists. We studied the influence of plant species richness, composition and food plant quality on the performance of different populations of the common grasshopper *Chorthippus parallelus* through field samplings as well as feeding experiments in the field and laboratory. We found a positive relationship between plant species richness and performance of grasshoppers from meadows differing in plant species richness and composition. Although grasshopper survival did not change between populations caged on different meadows a strong trend towards differences in fecundity was indicated in a reciprocal transplantation experiment. The performance of grasshopper individuals of 12 populations was not different when they were fed with diets consisting of plants from their meadow of origin. However, a significant difference in egested C/N ratio between grasshopper populations indicate an active maintenance of fitness through dietary mixing. Individuals fed on a nitrogen-rich but species-poor diet had a lower fitness than individuals fed on a diverse diet in a laboratory experiment. The results emphasize the fact that the generalist grasshopper *C. parallelus* is a plastic feeder that can achieve fitness benefits by dietary mixing.



**Olfactory orientation in the host plant finding of the weevil *Ceratapion onopordi****Esther Müller*<sup>1</sup><sup>1</sup> Ecology and Evolution, Community Ecology, University of Bern

The weevil *Ceratapion onopordi* Kirby (Coleoptera: Apionidae) interacts in a mutualistic like way with the rust fungus *Puccinia punctiformis* (Str.) Röhl. The rust fungus infects one of the weevils host plants, *Cirsium arvense* (L.) Scop. and profits from the weevils because they transport the fungal spores from plant to plant during egg deposition and feeding. The weevil seems to profit from rust infected plants in the way that larvae of the weevil that grew up in infected plants become heavier adults with a higher fecundity. Additionally a preference of the weevil for oviposition in rust infected shoots was observed in earlier studies. This could give an indication that the female weevils can orientate adjusted towards the infected thistle shoots. We detected two possible cues for that. First, the new build spermogonia are of bright, yellow colour, so that an orientation towards infected plants by visual orientation seems to be possible. Second the spermogonia detach a strong, flowery smell, presumably to attract insects for cross-fertilisation. This intensive fragrance could possibly be used by the weevils for deciding between healthy and infected plants. To test if the smell is responsible for the weevils' orientation we did some four-chamber olfactometer bioassays. Results show that the weevils orientate by olfactory cues towards their host plants, but do not decide between infected and uninfected ones because of the fragrance of the fungus.



**Examination of mechanisms of predator diversity on ecosystem functioning with biological control agents**

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In an experimental microcosm study three species of the aphidophagous guild were established together with grain aphids on barley. Applying a full-factorial additive design in combination with analyses of interaction strengths enabled to trace all per capita interactions among the species of the system. This allowed to disentangle effects of predator density (population level effects) and diversity (per capita effects). In a nutshell, (i) the largest predator, *Coccinella septempunctata*, had the strongest per capita and population level interaction strengths with the aphids resulting in a sampling effect. (ii) *C. septempunctata* was an intraguild predator of *Chrysoperla carnea*. Thus, *C. septempunctata* was the dominant predator for extraguild and intraguild prey. (iii) Increasing predator diversity decreased herbivore biomass and yielded a subsequent increase in total biomass of barley shoots and ears, despite the occurrence of intraguild predation. Thus, effects at the predator level did propagate down to the barley plants via a trophic cascade. In general, this study contributed to our understanding how effects of diversity can affect ecosystem processes, leading to a better prediction how species extinctions might alter this functioning. With respect to biocontrol, these results suggest that an effective keystone predator, *C. septempunctata*, should be preserved to maintain the ecosystems' capacity of controlling herbivorous outbreaks.



**Biodiversity as an important factor for mosquito control**

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Mosquitoes can heavily affect human health, as they are vectors for various diseases (e.g. malaria). However, common mosquito control strategies, based on the use of insecticides, started to fail due to resistance development. Therefore biological control strategies gained increasing interest. In field studies we investigated the impact of food competitors (i.e., crustaceans) on mosquito larval populations (i.e., *Aedes vexans*, *Culex pipiens* and *Culex territans*). Our results showed, that most mosquito larvae occur in new established ponds, which are characterised by low density of competitors and predators. However, as soon as natural communities of competitors developed, mosquito larvae disappeared. This fact is important for the common use of chemical pesticides (e.g. organophosphates), which affect not only mosquito larvae but also non-target species. However, if natural antagonists of mosquito larvae are eliminated, mosquito larval populations are able to recover rapidly. Indeed, our results showed, that mosquito larval populations recovered within 2 weeks after insecticide contamination, if competitors were absent. In contrast no recovery of mosquito larval populations was observed at presence of natural crustacean communities. An environment with low biodiversity thus favours the development of mosquito larval populations. For an effective and sustainable mosquito control it is therefore necessary to complement the use of insecticides by the use of a biological approach.



**Who decides whether the food is fine? The distinct response of leaf-cutting ants and their fungal partner to herbivory-induced plant volatiles.**

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Foraging behavior of leaf-cutting ants (LCAs) does not always follow the predictions of the optimal foraging theory as they (i) frequently abandon still profitable food plants before complete defoliation, (ii) often travel greater distances to forage, even if conspecific plants are located much closer to the nest. The 'Induced-defence hypothesis' provides an explanation for these observations: LCA-herbivory may result in the activation of plant defences generating a dynamic mosaic of plants at varying induction levels causing avoidance of high levels by workers. The aim of this study was to unveil whether *Atta colombica* workers perceive herbivore-induced plant volatiles (HIPVs) from induced lima bean plants. Ant workers were confronted with HIPVs in olfactory choice assays and the effects of HIPV on the growth of the symbiotic fungus was tested in growth inhibition assays. The results showed that: (1) workers from naive colonies did not discriminate between HIPVs and control; (2) both the mixture of all main HIPV components and several components alone inhibited the growth of the symbiotic fungus. Previous observed discrimination against induced plants by not naive colonies (viz. with incorporation of induced foliage in the fungus-garden) was missing at this experiment setting and can be interpreted as lack of information transfer about food quality from fungus to workers. These findings suggest participation of the fungus at foraging decisions and support the 'induced-defence hypothesis'.



**Hunger and food preference: Key factors for understanding functional response**

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Functional response, the number of prey eaten by a predator, is a key parameter determining population dynamics of predator-prey relationships. Functional responses have been primarily studied in single-prey settings; few authors concentrated on multiple-prey systems. Most of them offered prey simultaneously (cafeteria experiments) and typically considered prey density as the sole decisive factor. In nature however, predators generally feed on several prey which are differently preferred. Moreover, encounters of prey occur one at a time and the predator has to decide on the spot whether or not to eat the prey. We argue that not only the density but also the preference expressed by a predator and his satiation level determine the predator's choice. It is unclear if current descriptions of functional responses accurately capture predator foraging decisions in multiple prey systems. Experiments as well as modeling were used to tackle this question. Combinations of prey (crickets, flies and aphids) were offered sequentially to wolf spiders (*Pardosa sp.*) over a period of several days and all predation events were recorded. Results from the experiments were compared by Monte Carlo Markov chain techniques with outcomes of a stochastic multiple-prey model. We demonstrate that including predators' preference and satiation level substantially better explains predation than classic Holling type functional responses.



**Ecophysiology of auditory host detection***Reinhard Lakes-Harlan*<sup>1</sup><sup>1</sup> Integrative Sensory Physiology, University Giessen

*Emblemasoma auditrix* is a sarcophagid parasitoid which uses tympanal hearing to locate its host, the cicada *Okanagana rimosa*. In recent years data have been accumulated on the auditory behavior, physiological mechanism and ecological interactions in this system. Host and parasitoid occur in open forests in North Michigan, where their distribution has been evaluated by acoustic trapping. The acoustic behavior of both species depends on similar environmental conditions (e.g. sunny skies, temperature above 22°C). For host location the fly has evolved ears at the prothorax with astonishing physiological capacities, e.g. for 3D-hearing. Nevertheless, landmarks in the habitat are usually used for host approach. Ecologically, the relatively short hearing range (2-4m) of the parasitoid results in a high probability to stay at suitable patches. Interestingly, the host has almost no defense possibilities. Thus, the host has to make a trade-off between sexual reproduction and risk of parasitism during production of the acoustic signal. Modification of the acoustic signal did not exclude the parasitoid from host localization. An adaptation to the parasitism risk could be the semi-periodicity of the host. Every 5-8 years high density populations occur, with low density populations in between. However, the parasitoid seems to be adapted to this life-cycle with a perennial pupal diapause. An additional adaptation is the appearance early in season, perhaps a result of competition with a fungal parasite.



**Collembolan-induced fungal response to grazing damage – The occurrence of indirect defence volatiles in the soil system***Susanne Pfeffer*<sup>1</sup>, Juliane Filser<sup>1</sup><sup>1</sup> General and Theoretical Ecology, University of Bremen

Grazing by herbivorous arthropods induces changes in the volatile signal pattern of many plant species in aboveground systems which attract natural predators of the herbivores. Even though chemical signalling plays an important role for food and prey location of soil dwelling organisms, only few studies have concentrated on comparable processes in the soil system. So far, studies on induced grazing effects have mainly focused on belowground plant tissue. As soil fungi provide the main food source for a great number of soil organisms, we studied whether indirect induced defence occurs in soil fungi as well. We therefore examined the olfactorial response of the soil mite *Hypoaspis aculeifer* to collembolan-caused grazing damage in open air dual choice olfactometers as well as under soil conditions. The mites' choice behaviour was significantly influenced by volatile perception. However, the response differed significantly depending on fungal species tested and the experimental set up. Mites preferred cues originating from the collembolan prey to the grazed fungal mycelium or vice versa, or did not distinguish at all between collembolan and fungal cues. Out of eight tested fungal species, induced indirect defence response was found for two *Trichoderma* species, *T. viride* and *T. harzianum*. This study gives first evidence for grazing-induced defence volatiles in soil fungi.



**Endophytic fungi influence aphid abundance depending on study region**

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Fungal endophytes are symbionts of all vascular plant species. The mutualistic asexual fungus *Neotyphodium* of cool season grasses produces alkaloids, which increase the biomass of its host plant under environmental stress and are toxic to herbivorous insects. But most studies considering insect herbivores and endophytes were conducted under laboratory conditions only. The few existing field studies show ambiguous results; some have shown a negative effect of endophytes on herbivores while others have shown a positive effect. A possible explanation for these contradicting results might be unspecified regional effects. Therefore we conducted our field experiment in two different regions, where we chose intensively and extensively managed grasslands as study sites. On each study site we installed four experimental grass pots, half infected with *Neotyphodium* fungus and the other half uninfected. Aphids were exposed and their population size was recorded every second week. We also studied the effects of predator on aphid abundance and excluded predators from half of the pots. The experiment showed that the study region modifies the effect of endophytic fungi, as it had a significantly negative effect on aphid abundance only in one region. We further showed that predators have a stronger effect on aphid population size than endophytic fungi. Against our expectations aphid control by predators was better on intensively managed grasslands than on extensively managed grasslands.



**Individuals in a community context: Neighboring plants structure the composition of arbuscular mycorrhizal fungi in individual ragwort plants**

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Arbuscular mycorrhizal fungi (AMF) are important in many ecosystems. The effect of AMF on invasiveness, community composition and diversity are well studied. We focus on the reversed question: How does the surrounding vegetation influence the diversity and composition of the AMF community in individual plants? We determined the AMF community composition in individual *Senecio jacobaea* plants growing in an experimental old-field in sown and unsown plant communities that differ in composition, diversity and heterogeneity. We determined the AMF community composition using terminal restriction fragment length polymorphism (T-RFLP). AMF composition did not differ between *Senecio* plants from sown and unsown plant communities. However, unsown plant communities were more heterogeneous than the sown communities and remarkably, the AMF community composition between plants was also less similar in these unsown communities. Our study clearly shows that there is a direct link between heterogeneity of the plant community and the heterogeneity of the soil community associated to individuals growing within the plant community. We will discuss how neighboring plants, via their impact on soil organisms that interact with *Senecio* can influence the long-term dynamics of this species.



**Litter dissimilarity and macro-fauna identity drive litter diversity effects**

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Up to 90 % of plant production enters the dead organic matter pool, making decomposition a key component of ecosystem functioning. At the moment it is not clear how biodiversity loss may affect this important process, but changes across trophic levels are likely to alter decomposition. To test this, we simultaneously manipulated leaf litter and macro-detritivore diversity in a large field experiment. Importantly, leaf litter mixtures were selected to cover a gradient in dissimilarity in key litter traits. This allowed us to compare the relative importance of species and functional litter diversity. The additive partitioning method was used to gain further insight into the underlying mechanisms. Our results show that litter diversity effects only occurred in the presence of macro-detritivores, but the effect on both mass loss and diversity differed between species. Animal diversity positively affected mass loss but did not affect diversity effects. Although litter dissimilarity had no overall effect on mass loss, it was important for litter diversity effects. Dissimilarity was positively related to complementarity effects and showed a negative relationship with selection effects. We conclude that functional litter diversity and detritivore presence are important for decomposition whereas detritivore diversity is probably less important.



POSTER PRESENTATIONS:**Impact of generalist predators and different levels of NPK fertilization on soil fauna, plant performance and herbivore populations in barley**

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Generalist predators are dominant components of terrestrial food webs and affect above- and belowground processes such as decomposition and plant growth. Nutrient availability is a major driver of such processes and directly related to fertilizer application in agroecosystems. In a full-factorial experiment in a barley field, we manipulated generalist predator abundance by exclusion barriers and nutrient availability by altering levels of NPK-fertilization. Effects on generalist predators, herbivores, soil fauna, soil fauna feeding activity, decomposition and plant height were analyzed. Lycosids and herbivorous Coleoptera, Hemiptera and Thysanoptera were significantly more abundant in plots with a high fertilizer level, whereas Gamasida, Entomobryomorpha and Poduromorpha were less abundant. Under reduced predator abundance soil fauna feeding activity was higher in low fertilizer level treatments only, while feeding activity did not differ between fertilizer levels under increased predator abundance. Our results indicate that enhanced NPK-fertilization may have positive effects on herbivores and generalist predators and negative effects on soil organisms. Belowground processes are affected synergistically by predator abundance and nitrogen availability. Understanding effects of management and predation on below- and aboveground arthropod communities and associated processes may contribute to the development of conservation biological control strategies in the future.



**Earthworm activity mediates litter effects on seedling emergence***Tobias Donath*<sup>1</sup>, Lutz Eckstein<sup>1</sup><sup>1</sup>Institute of landscape ecology and resources management, Justus-Liebig-University Giessen

Establishment of plants through seeds, and thus community invasibility and community assembly, is often constrained by species-specific characteristics and the quality of microsites, which is influenced by litter amount and litter dynamics, e. g. through litter consumers such as earthworms. Earthworms will also affect seeds' fate directly since they bury or consume and digest seeds. While it is widely accepted that seedling emergence increases at lower litter quantities and decreases when litter amount lies above a certain threshold, which depends on species-specific traits and environmental conditions, little is known how this general pattern changes in the presence of earthworms capable of burying and consuming both litter and seeds. We explicitly addressed to what degree earthworm activity does influence seedling emergence when seeds are exposed to different litter amounts and differ in sowing position. In addition, we also studied the fate of seeds buried into the soil, i. e. if seeds remain germinable after burial. To this end we experimentally studied seedling emergence of five Apiaceae species differing in seed size in response to litter quantity (0, 0.4, 0.8 kg m<sup>-2</sup>), sowing position (top and beneath) and earthworms (present vs. absent). First results indicate that the presence of earthworms significantly lowers seedling emergence but does not equalize the effects of sowing position and litter quantity.



## Comparing geographical structures of one cynipid gall wasp and two parasitoids in Europe

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Current phylogeographical structures might be similar for interacting species pairs like parasitoids and their hosts because they are often highly specialised and they share the same habitat. Therefore, similar phylogeographic population structures for host-parasitoid-pairs could be expected. Here, we compare the geographical structures of the cynipid gall wasp *Diplolepis rosae* L. (Hym., Cynipidae) and two of its most common parasitoid species *Orthopelma mediator* Thunbr. (Hym., Ichneumonidae) and *Glyphomerus stigma* Fabr. (Hym., Thorymidae). We analysed insect individuals from Europe with two genes (COI and ITS 2). An additional factor influencing current geographical structures might be the infection with *Wolbachia* bacteria which alter the reproduction strategy, and thereby the dispersal ability, of its host. The infection rate with *Wolbachia* bacteria demonstrated quite different patterns: *D. rosae* 86%, *O. mediator* 32% and *G. stigma* was not infected. Contrary to our expectations, the geographical structure of the three species was incongruent. The gall wasp had the lowest genetic diversity with one major central clade, *O. mediator* showed a classical European distribution with one eastern and one western clade, whereas *G. stigma* had the highest diversity but no geographical structuring. Two main reasons are plausible, first the free living stages as adults with different possibilities to disperse and second the ability to switch between host species, if the primary host is not available.



**Reshuffling the pack: Examining the consequences of introduced species on community structure. Plant-insect interactions of coastal Asteraceae and the role of phylogeny, landscape and scale**

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Coastal areas in New Zealand have been subject to various introductions of alien plants; however, the consequences for native biota and their associated community structure still remain largely unknown. Although the ecologic and economical impacts of introduced species are well recognized, basic ecological questions regarding the impact of increasing numbers of introduced species on plant-herbivore communities remain unanswered. Our study system comprises *Senecio* plants (*S. elegans*, *S. glastifolious*, *S. lautus*, *S. skirrhodon*, *S. vulgaris*); together with the focal insects of seed head predators, leaf rollers, leaf miners and lepidopteran larvae. Our research aim is to investigate to what extent apparent competition influences food web structure, particularly questions linking host specificity with phylogeny, morphology and food web quantities. Our investigations will span several scales: (1) the influence of individual plant properties on the likelihood for insect reproduction, (2) direct and indirect consequences of novel feeding associations at a population level, (3) differences in food web properties in communities with introduced vs. native dominated species, and (4) the changes of food web properties within the landscape context. From these results we expect to gain valuable insights into the factors influencing food web properties that have important practical conservation implications.



## How specialized are interactions between ants and aphids

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Aphids and ants are two very successful insect groups. Often they live together in the same habitat. Hence it is likely that they interact with each other.

Aphids feed on plant juices. As excretion, aphids produce carbohydrate-rich excreta, the honeydew. Ants have a preference for these excretions of the aphids.

In temperate regions, aphids are the most important honeydew producers, so that many aphid species have developed a mutualistic relationship with ants, called trophobiosis. It is believed that in some cases trophobionts are marked by ants with an ant colony specific odour to discriminate aphids which are tended by another ant colony.

We examined in a field experiment how specialized the interactions between ants and aphids are. This experiment was conducted in the region of Bern by mapping trophobioses. Further, it was determined in a laboratory test, whether ants can discriminate between different aphid species. In a second laboratory experiment, the cuticular hydrocarbons of aphids will be assigned by GC-MS.

The following assumptions were tested: 1. Some combinations of ants and aphids occur significantly more often as a trophobiotic relationship than others; 2. Tending behaviour is triggered through cuticular hydrocarbons; 3. Ants are able to distinguish aphid species, for example tended and non-tended species, because of different cuticular hydrocarbon profiles of the aphids.



**Differences in predation of dog rose seeds between hedges and forest edges**

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Seed predation and dispersal affect plant populations and can influence composition of plant communities. Pattern and strength of interactions between plants and animals may differ between habitats and their degree of isolation. We performed an experiment with dog rose (*Rosa canina*) seeds at three habitat types with six replicates each: forest edges, hedges connected to forests and hedges isolated from forests. We introduced four sampling stations per study site containing three selectively accessible dishes with 10 dog rose seeds to determine the impact of different predator groups. Seed loss (removed and opened seeds) through vertebrates was significantly higher at isolated hedges than at forest edges. The number of opened seeds (predated but not removed seeds) was significantly higher at isolated hedges than at connected hedges and forest edges. Since we found opened seeds almost exclusively in freely accessible dishes we conclude that vertebrates act as major predators for dog rose seeds. Seed predation by vertebrates may be higher at isolated hedges than at forest edges because forests, bordering forest edges, may provide a wide range of alternative resources in contrast to agricultural landscapes, bordering isolated hedges. Higher seed predation in isolated hedges in comparison to forest edges may result in a smaller dog rose seed bank in isolated hedges and therefore affect reproduction and plant communities.



**The effect of habitat heterogeneity on the spatial relationship between two competing predators in a forest floor habitat**

*Elvira Melnichnova*<sup>1</sup>, Theo Blick<sup>2</sup>, Wolfgang H.O. Dorow<sup>2</sup>, Volkmar Wolters<sup>1</sup>, Klaus Birkhofer<sup>1</sup>

<sup>1</sup> Tierökologie, JLU Giessen

<sup>2</sup> Forschungsinstitut und Naturmuseum Senckenberg

Disentangling the contribution of biotic interactions and environmental heterogeneity to the formation of spatial patterns between predators is crucial for a better understanding of food-web interactions. We studied the spatial relationship between two abundant spider species and its dependence on habitat heterogeneity in the Kellerwald strict forest reserve “Locheiche”. Both spider species were sampled at monthly intervals throughout a 12 month study period utilizing a regular sampling grid of pitfall traps. Temperature loggers recorded microclimate data at each trap location and techniques for spatial point pattern analysis were used to describe spatial relationships between individuals of both species while accounting for environmental heterogeneity. It was found that both *C. terrestris* and *T. zimmermanni* preferred areas with cooler microclimates, but still co-occurred less frequently than under the assumption of independent occurrence (i.e. were segregated). Additional data on both species highlights the fact that the observed spatial distributions are a consequence of both: a) microhabitat needs and b) biotic interactions between individuals of two potentially competing species. Our analyses further demonstrate the need to account for habitat heterogeneity while analyzing species interactions in space, as oversimplified spatial analyses may lead to a spurious description of aggregation or species-species associations.



**Effects of generalist root feeders (*Agriotes spp* larvae, Elateridae) on grassland plant species**

Ilja Sonnemann<sup>1</sup>, Susanne Wurst<sup>1</sup>

<sup>1</sup> Plant Ecology, Free University of Berlin

Generalist root feeders likely influence plant community structure because (i) they may preferentially feed on certain plant species and (ii) plant species may differ in their ability to cope with the root herbivore attack. In two greenhouse experiments we investigated the impact of *Agriotes* spp larvae on grassland plant species. In the first experiment, 9 grassland plant species belonging to 3 functional groups (herbs, grasses, legumes) were grown separately either with or without larvae. For herbs and grasses, the root herbivores reduced total plant biomass independent of plant species or group, with biomass losses ranging from 8,5 to 55 % for different species. Contrastingly, legume species were not affected by the root herbivores. Growth of *Agriotes* larvae was positively correlated with root biomass, but apart from that did not depend on plant species or group. In a second experiment, a community of six grassland plant species was grown in soil biota communities from two different grassland sites, either with or without larvae. Under interspecific competition, shoot biomass of two plant species out of six was decreased and increased respectively in the presence of the root herbivores, and this effect depended on the soil biota community. We conclude that *Agriotes* spp may change interspecific plant competition by (i) feeding on the roots that are most abundant, (ii) affecting certain plant groups more than others. However, their impact may vary depending on the background soil biota community.



**Seed dispersal by slugs**

Manfred Türke<sup>1</sup>, Kerstin Andreas<sup>1</sup>, Wolfgang Weisser<sup>1</sup>

<sup>1</sup> Institute of Ecology, University of Jena

Myrmecochory or seed dispersal by ants is a worldwide and common mechanism of plants to disperse their diaspores. This phenomenon was illuminated by numerous workers for more than one hundred years. Seed dispersal can be ant-limited in some habitats as is the case in European beech forests. We found that large Arionid slugs swallow seeds of myrmecochores and defecate them intact and germinable in the laboratory as well as in the field and thus acting as seed dispersers. Their contribution to seed removal in beech forests in three regions (Biodiversity Exploratories) in Germany was high. We investigated the role of slugs as seed dispersers of myrmecochores in more detail. We found that less defecated seeds than control seeds were removed from seed depots in a forest seed predation experiment. This was a meaningful question as predator-avoidance is a hypothesis often mentioned as a reason for the evolution of myrmecochory. We assessed potential dispersal distances permitted by slugs combining gut passage times for seeds and slug movement in the field and compared distances to those permitted by ants. And we could show for the plant *Anemone nemorosa* that slug mediated seed dispersal could describe migration rates previously found for this plant species while ants are less likely to promote these migration rates. We conclude that slugs could be favourable dispersal agents for myrmecochores in addition and also as a substitute to ants.



## **Foxes as dispersers of forest tree seeds in southern Brazilian grasslands**

*Julia-Maria Hermann*<sup>1</sup>, Laura Beatriz Prates da Silva<sup>2</sup>

<sup>1</sup>Technische Universität München

<sup>2</sup>Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

Seed dispersal is probably a major limiting factor in grassland-forest-succession in southern Brazil. In a small 2006 pilot study on the role of native fox species as forest tree seed dispersers in grasslands, we determined a) seed species composition in faeces – principally three fleshy-fruited species from forest interior to border -, b) seedling emergence from seeds after gut passage – between 26 and 34 %, c) seedling emergence in faecal piles in their original locations – variable: <1% in 2 species, 77% in another. The results emphasize the need to investigate in more detail the efficiency of seed dispersal by native mammals in early and later stages of grassland-forest-succession.



**Effects of interactions between arbuscular mycorrhizal fungi, rhizobacteria, soil phosphorus and plant cytokinin levels on tobacco growth**

Marco Cosme<sup>1</sup>, Eswar Ramireddy<sup>2</sup>, Thomas Schmülling<sup>2</sup>, Susanne Wurst<sup>1</sup>

<sup>1</sup> Freie Universität Berlin, Funktionelle Biodiversität, Germany

<sup>2</sup> Freie Universität Berlin, Angewandte Genetik, Germany

The main functions of roots are plant anchorage and uptake of water and nutrients. When growing in a complex medium such as soil with high environmental variability, roots develop in a structured but flexible manner to optimize their functions. Endogenous factor, such as plant physiology and genetics, as well as abiotic and biotic exogenous factors are important determinants. In the present study we hypothesized that the effects of soil microorganisms on root morphology and plant growth of tobacco differ depending on endogenous phytohormone levels and soil nutrient availability. A full factorial experiment was set up in the greenhouse, with presence or absence of *Glomus intraradices* or *Pseudomonas fluorescens*, with two phosphorus amendments (15 or 30 mg kg<sup>-1</sup>), and with the tobacco wild type (*Nicotiana tabacum* L. cv. Samsun NN) or a transgenic line with root-specific expression of a cytokinin oxidase/dehydrogenase (*CKX*) gene, resulting in a reduction of the plant cytokinin content. Four way interactions including all treatments were detected on plant dry mass ( $P < 0.01$ ) and the root to shoot ratio ( $P < 0.05$ ) of the two-month-old tobacco plants. The effects of microorganisms on both parameters changed from negative to neutral and positive depending on plant type, phosphorus amendment and microorganism presence. Further results on root morphology, AMF root colonization and the chemical profile of the plants will be presented and the potential mechanisms discussed.



**Effects of *Glomus intraradices* on the larvae performance and ovipositional preference of the rice water weevil (*Lissorhoptrus oryzophilus* Kuschel)**

Marco Cosme<sup>1</sup>, Michael J. Stout<sup>2</sup>, Susanne Wurst<sup>1</sup>

<sup>1</sup> Freie Universität Berlin, Funktionelle Biodiversität, Germany

<sup>2</sup> Louisiana State University, Department of Entomology, USA

The rice water weevil, *Lissorhoptrus oryzophilus* Kuschel, a semiaquatic Coleoptera native to the Mississippi river basin, is currently the most destructive insect pest of rice in North America and has recently invaded Eastern Asia. The adult weevils feed on the aerial part of the plant, causing insignificant damage, and the larvae feed on the roots, pruning them severely, which results in loss of plant vigor and reduced yield. Flooding of rice paddies is a major stimulus for weevil oviposition and also reduces the root colonization by arbuscular mycorrhizal (AM) fungi. Besides increasing the nutrient availability for plants, AM fungi can reduce the performance of root feeding insects. We hypothesize that according to the “preference–performance hypotheses” rice water weevil females preferentially oviposit on host plants with lower or no AM fungi colonization on which their offspring may perform better. To test these hypotheses two experiments were set up in the greenhouse. Ovipositional preference was tested as a binary choice test, where a mating pair of weevils was allowed to choose to feed, mate and oviposit on an AM rice plant (*Oryza sativa* ssp. japonica ‘Nipponbare’) or a non-AM control. Larvae performance was tested by adding 1<sup>st</sup> instar larvae into pots containing either an AM rice plant or a non-AM control. Female preference, larvae survival and biomass, plant biomass, root mycorrhizal colonization and nutrients in shoot and roots will be presented and discussed.



**Characterization of initial soil food webs – Micro- and mesofauna in a post mining area**

Cornelia Rißmann<sup>1</sup>, Michael Elmer<sup>1</sup>, Karin Hohberg<sup>2</sup>, Thomas Raab<sup>1</sup>, Willi Xyländer<sup>2</sup>

<sup>1</sup> Brandenburg University of Technology Cottbus, Chair of Soil Protection and Recultivation

<sup>2</sup> Senckenberg Museum of Natural History Görlitz

The development of initial soil food webs is one of the first important stages in the process of primary succession and recultivation of a post mining area. Especially the organisms of micro- and mesofauna – such as nematodes, tardigrades, springtails and mites are the first components of early soil food webs and play an important role to initialize the nutrient cycle. Little is, however, known about the key factors that affect the initial food web composition and the trophic interactions within the system. Initial soil food webs in a post mining area in Lower Lusatia are studied, where five different treatments had been applied: natural vegetation, sowing of *Lotus corniculatus*, litter of *L. corniculatus* and of *Calamagrostis epigejos* and control (without vegetation). Soil samples were taken 6, 11, 18 and 49 weeks after treatment. Micro- and mesofauna were extracted according to Baermann and MacFadyen; nematodes, tardigrades, springtails and mites were counted; nematodes were determined and assigned to feeding groups. Other components and parameters of the soil food web have been assessed quantitatively (e.g., nematode biomass). First results reveal the complex trophic structure of these initial soil food webs.



## **Foxes as dispersers of forest tree seeds in southern Brazilian grasslands**

*Julia-Maria Hermann*<sup>1</sup>, Laura Beatriz Prates da Silva<sup>2</sup>

<sup>1</sup>Technische Universität München

<sup>2</sup> Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

Seed dispersal is probably a major limiting factor in grassland-forest-succession in southern Brazil. In a small 2006 pilot study on the role of native fox species as forest tree seed dispersers in grasslands, we determined a) seed species composition in faeces – principally three fleshy-fruited species from forest interior to border -, b) seedling emergence from seeds after gut passage – between 26 and 34 %, c) seedling emergence in faecal piles in their original locations – variable: <1% in 2 species, 77% in another. The results emphasize the need to investigate in more detail the efficiency of seed dispersal by native mammals in early and later stages of grassland-forest-succession.



## SESSION 14 - BEYOND PATTERNS - NICHE DYNAMICS IN SPACE AND TIME

CONVENOR: MARTEN WINTER, HOLGER KREFT, CHRISTIAN HOF

ORAL PRESENTATIONS:

### The impact of changing environment on bovids evolution in Africa

Tim Schikora<sup>1</sup>, Schrenk Friedemann<sup>2</sup>

<sup>1</sup> Evolution und Klima, Biodiversität und Klima Forschungszentrum

<sup>2</sup> Senckenberg Forschungsinstitut und Naturmuseum

The Bovidae family is the most successful mammal group in Africa, at least in terms of diversity and species count. 80 cattle and antelope like species live on the African continent only, and are inhabitants of all available habitats, from the Sahara dwelling Oryx-Antelope (*Oryx gazella*) to the hidden Duiker (Cephalophini) species of tropic forests. Moreover, not only the habitats are very different, although the morphology of extant bovids is varying extremely. So is the weight of the African Buffalo (*Syncerus caffer*) or the Giant Eland (*Taurotragus derbianus*) with up to 1000 kg more as 300 times the weight of a 3 kg Dwarf-Antelope (Neotragini). All these variations are results of necessary adaptations to again and again changing climate and consequently changing environments. However, few is known about the process of adaptation – or the evolution of this family. Former assessments are based on studies of fossils, which are used, for example, for the reconstruction of palaeohabitats. Nowadays molecular techniques enable us to date certain speciation events additionally to classic palaeontological methods. The resulting dated phylogeny or chronogram sheds light on correlations between climate change, distribution of forage crops and speciation.



**Out of New Guinea: Non-density dependent cladogenesis in several families of core-corvid passerine birds**

*Susanne Fritz*<sup>1</sup>, Knud Jønsson<sup>2</sup>, Jon Fjeldså<sup>2</sup>, Carsten Rahbek<sup>1</sup>

<sup>1</sup> Center for Macroecology, Evolution and Climate, Department of Biology, University of Copenhagen

<sup>2</sup> Center for Macroecology, Evolution and Climate, Zoological Museum, University of Copenhagen

Numerous studies have used molecular phylogenies of various vertebrate groups to demonstrate a pattern of density-dependent diversification, where initial rapid speciation is followed by a slowdown in net diversification rates. This pattern has been linked to niche-filling theory, where an adaptive radiation takes place into new ecological niches with initially high diversification rates and a subsequent slowdown as niche space fills up. We investigated patterns of diversification for four families of passerine birds: one family is mostly restricted to New Guinea, and the three others probably originated in New Guinea but have since dispersed throughout the Indo-Pacific archipelagos and to continental Asia and Africa. Using near-complete molecular phylogenies, we demonstrate the common pattern of density-dependence for the range-restricted birds-of-paradise, but a pattern of constant net diversification for the three widespread families. Contrary to nearly all previous studies of adaptive radiations in birds, our results suggest that diversification rates do not necessarily slow down in dynamic biogeographical regions. Instead, they may depend on dispersal opportunities and dispersal abilities within given groups.



**Polyploid evolution and habitat segregation in the *Senecio carniolicus* complex**

Karl Hülber<sup>1</sup>, Manuela Winkler<sup>2</sup>, Pedro Escobar García<sup>2</sup>, Ruth Flatscher<sup>2</sup>, Gerald Schneeweiß<sup>2</sup>, Michaela Sonnleitner<sup>2</sup>, Peter Schönswetter<sup>2</sup>

<sup>1</sup> Vienna Institute for Nature Conservation & Analyses

<sup>2</sup> University of Vienna, Department of Biogeography and Botanical Garden

*Senecio carniolicus* Willd. (Asteraceae) is a common acidophilic species of alpine to subnival grasslands, moraines and stable scree slopes occurring in the Eastern Alps and the Western and Southern Carpathians. A recent study revealed large ploidy level variation within the species, including many populations with stable cytotype mixtures. Diploids and hexaploids are widespread in the Alps, while tetraploids are restricted to two disjunct areas, which correspond to putative Pleistocene refugia. In the north-western part of the distribution area (i.e., the area most strongly glaciated during the Pleistocene), exclusively hexaploids occur. Using plastid and ITS sequences, low-copy nuclear markers and AFLP data we unravelled the polyploid evolution of the group including the origin of cytotype mixture (primary or secondary hybrid zones). Our data suggest two genetically separated diploid lineages: while the Eastern lineage is closely related with polyploids occurring throughout the Eastern Alps, the Western lineage is genetically distinct. We found a similar pattern of habitat segregation in both pure and mixed populations with diploids growing in more open, rocky habitats, while hexaploids were linked to more nutrient-rich communities with dense vegetation, and tetraploids being intermediate. Ploidy level and altitude also appeared to be correlated, with hexaploids occurring at significantly lower altitudes than diploids and tetraploids.



**Linking large scale analyses of climate niche evolution with population genetics**

*Dennis Rödder*<sup>1</sup>, Sabine Jakob<sup>2</sup>, Christoph Heibl<sup>3</sup>, Frank Blattner<sup>2</sup>

<sup>1</sup>Biogeography Department, Trier University

<sup>2</sup>Leibniz Institute of Plant Genetics and Crop Research

<sup>3</sup>Systematic Botany, Ludwig-Maximilians University

In this study, we explore the interplay of population demography with the evolution of ecological niches during or after speciation in *Hordeum*. While large populations maintain a high level of standing genetic diversity, gene flow and recombination buffers against fast alterations in ecological adaptation. Small populations harbour lower allele diversity but can more easily shift to new niches if they initially survive under changed conditions. Thus, large populations should be more conservative regarding niche changes in comparison to small populations. We used environmental niche modelling together with phylogenetic, phylogeographic and population genetic analyses to infer the correlation of population demography with changes in ecological niche dimensions in 12 diploid *Hordeum* species from the New World, forming four monophyletic groups. Our analyses found both shifts and conservatism in distinct niche dimensions within and among clades. We provide evidence that species, which did not encounter population reductions mainly showed ecoclimatic niche conservatism, while major niche shifts occurred in species which have undergone population bottlenecks. Our data allow the conclusion that population demography influences adaptation and niche shifts or conservatism in South American *Hordeum* species.



**Phylogenetic signal in community niche structure**

*Tamara Münkemüller*<sup>1</sup>, Sébastien Lavergne<sup>1</sup>, Wilfried Thuiller<sup>1</sup>

<sup>1</sup> Laboratoire d'Ecologie Alpine, CNRS

Understanding the development and implications of community niche structure is a longstanding goal in ecology. Recently this 'old' goal has triggered a new focus on the intersection of ecology and phylogenetics. Exploring the phylogenetic basis of those traits that are related to ecological strategies, niches and coexistence gives new insights in the evolution of community niche structure. These new insights can help answering questions like: How similar are coexisting species? Do we expect global change to result in a non-random loss of (phylogenetic) biodiversity? Which lineages have the best chances to adapt rapidly to changing conditions? One way to study the phylogenetic basis of traits is to measure their phylogenetic signal, i.e. the tendency for related species to resemble each other more than they resemble species drawn at random from the phylogenetic tree. Metrics of phylogenetic signal should, in theory, allow to compare the tempo and mode of trait evolution in different traits and lineages. However, different metrics can give very different results. In this work, we study the performance of different metrics of phylogenetic signal based on artificial data-sets (comparing traits that evolved along phylogenetic trees with different numbers of species, different models of trait evolution, and under the influence of polytomies and branch lengths). Further, we demonstrate with large scale plant data how patterns of phylogenetic signal can be used to answer central questions of species conservation.



**Cryptic niche conservatism among evolutionary lineages of an invasive lizard**

Ulrich Schulte<sup>1</sup>, Stefan Lötters<sup>1</sup>, Michael Veith<sup>1</sup>, Axel Hochkirch<sup>1</sup>, Dennis Rödder<sup>1</sup>

<sup>1</sup> Biogeography Department, Trier University

There is increasing evidence that the quality and breadth of ecological niches vary among individuals, populations, evolutionary lineages and therefore also across the range of a species. Sufficient knowledge on niche divergence among clades might thus be crucial for predicting the invasion potential of species. We used species distribution models (SDMs) based on climatic information at native and invasive ranges to test for intraspecific niche divergence among mtDNA clades of the invasive Wall Lizard *Podarcis muralis*. Using a DNA barcoding approach, we assigned 77 invasive Wall lizard populations in Central Europe to eight evolutionary lineages with distinct geographic origin. Then we tested whether these evolutionary lineages vary in their climate niches and if these differences might explain their invasive potential. Six clades had rather similar realized niches in their native and invasive ranges, while inter-clade niche differentiation was greater. However, our results showed only a weak correlation between the geographic origin (i.e. the phylogenetic lineage) and invasion success. Our results indicate that the observed niche differentiation among evolutionary lineages is mainly driven by niche realization and not by differences in their fundamental niches. Such cryptic niche conservatism might hamper the success of clade-specific niche modeling.



**Inferring large-scale patterns of niche evolution and dispersal limitation from the phylogenetic composition of assemblages: A case study on New World palms**

*Wolf L. Eiserhardt<sup>1</sup>, Jens-Christian Svenning<sup>1</sup>, William J. Baker<sup>2</sup>, Thomas L. P. Couvreur<sup>3</sup>, Henrik Balslev<sup>1</sup>*

<sup>1</sup> Ecoinformatics and Biodiversity Group, Aarhus University, Denmark

<sup>2</sup> Royal Botanic Gardens, Kew, UK

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How fast species' environmental tolerances can evolve is crucial for their survival prospect under climate change. Phylogenetic information can yield insights into the tempo of niche evolution. Phylogenetic community structure (PCS) complements the more widely used approach of studying niche parameters in a trait evolution framework: it avoids using summary statistics for niche parameters, keeps spatial information - and thus information on niche filling - and separates the effects of niche conservatism and dispersal limitation. We analyse palm assemblages in the Americas, hypothesising: 1) there are centres of in situ-diversification defined by climate and geomorphology. 2) The phylogenetic relatedness of assemblages decreases both with increasing environmental dissimilarity and geographical distance, but a significant part of its variation is explained by environment alone and reflects niche conservatism (not dispersal). 3) The relatedness of species within assemblages correlates with environment in a way that reflects niche conservatism s. str., i.e. transition into extreme environments rarely occurs. We found phylogenetic clustering of assemblages, and centres of diversification that match geomorphology and climate well. A significant independent contribution of environment to explaining the phylogenetic relatedness of assemblages was found, indicating that niches are conserved in evolutionary time. Our results underline the value of the PCS approach to niche evolution.



**Functional and phylogenetic characteristics of spontaneous garden floras**

*Sonja Knapp*<sup>1</sup>, *Lucy Dinsmore*<sup>2</sup>, *Cinzia Fissore*<sup>3</sup>, *Sarah Hobbie*<sup>3</sup>, *Ina Jacobsdottir*<sup>3</sup>, *Jennifer King*<sup>3</sup>, *Stefan Klotz*<sup>1</sup>, *Joseph McFadden*<sup>3</sup>, *Jeannine Cavender-Bares*<sup>3</sup>

<sup>1</sup> Department Community Ecology, UFZ - Helmholtz Centre for Environmental Research

<sup>2</sup> University of Minnesota, Department of Horticulture

<sup>3</sup> University of Minnesota, Department of Ecology, Evolution and Behaviour

Urban areas are among the most heavily managed land-use types in the world. Still, they are remarkably species rich. Private gardens are frequently found in urban areas. The spontaneous species pool of gardens is subjected to conditions typical for urban environments and typical for gardens, i.e. environmental filters. Accordingly, we expect the spontaneous garden flora to have specific functional and phylogenetic characteristics. Function and phylogeny have become increasingly recognized as critical to understanding processes of community assembly even in managed systems. Knowledge of functional and phylogenetic patterns can help to manage gardens in a way that promotes biodiversity, in and beyond gardens. We compared the vascular flora of 137 gardens in the Twin Cities metro area, Minnesota, with the regional species pool. We analysed the frequency of functional trait attributes and phylogenetic lineages. Functionally, the garden flora differed significantly from the regional species pool. Characteristics of the garden flora were, e.g., high proportions of self-compatible species (related to urban habitat fragmentation), low plant height and low proportions of perennials (related to disturbance in the gardens and the urban matrix). The proportion of exotics in the gardens exceeded both the proportion in the regional species pool and proportions typical for cities. Phylogenetic analyses were not finished, yet, when this abstract was submitted, but will be reported, too.



**Demographic models for species distribution: Consequences for biodiversity maintenance in the face of environmental change**

*Juliano Sarmiento Cabral*<sup>1</sup>, Frank Schurr<sup>2</sup>, Florian Jeltsch<sup>2</sup>

<sup>1</sup> University of Göttingen

<sup>2</sup> Plant Ecology and Nature Conservation working group, University of Potsdam

How species will react to global change is largely on debate, but how demographic processes influence range dynamics of species is still poorly investigated. For this task, process-based models that consider demographic processes are needed. Therefore, the present work aims to investigate species response to habitat loss and climate change by using a process-based model for species range dynamics that can be fitted to abundance data and that simulates species' demography. We fitted this model for eight Proteaceae species and assessed the consequences of past habitat loss, future climate change and their interaction on plant response. There was quantitative agreement between independent data and parameter estimates. Both habitat loss and climate change scenarios had strong negative impacts on species dynamics. Climate change affected mainly range size and range filling due to habitat shifts combined with low colonization. Habitat loss affected mostly local abundances. The scenario with both habitat loss and climate change was the worst for most species. However, this impact was better than expected by simple summing of separate effects. This is explained by shifting ranges to more pristine areas. Range size response was better predicted by the strength of environmental change, while range filling and local abundance responses were better explained by species' demography. Surviving populations were restricted mostly to refugia, which can be key conservation focus.



**Moving to stand still – The influence of the habitat niche on dragonfly dispersal and their ability to track climate change**

*Christian Hof*<sup>1</sup>, Martin Brändle<sup>2</sup>, D. Matthias Dehling<sup>2</sup>, Mariana Munguía<sup>3</sup>, Roland Brandl<sup>2</sup>, Miguel B. Araújo<sup>4</sup>, Carsten Rahbek<sup>1</sup>

<sup>1</sup> Center for Macroecology, Evolution and Climate, University of Copenhagen

<sup>2</sup> Department of Ecology (Animal Ecology), Faculty of Biology, Philipps-Universität Marburg

<sup>3</sup> Instituto Biología, Universidad Nacional Autónoma de Mexico

<sup>4</sup> Biodiversity and Global Change Lab, Museo Nacional de Ciencias Naturales (CSIC), Madrid

Habitat shapes life history traits and ecological characteristics of species. The persistence of habitats should influence the dispersal of species, selecting for stronger dispersal in habitats of lower temporal stability. As standing freshwater bodies (lentic habitats) are on average less persistent over time than running waters (lotic habitats), lentic species should show a higher propensity for dispersal than lotic species. Assuming that climatic conditions are an important determinant of species distributions, we hypothesize that the distributions of lentic species should be closer to equilibrium with current climatic conditions and that lentic species should more rapidly track climatic changes. We tested these hypotheses using two datasets (from 1988 and 2006) of European dragonfly distributions and the according climatic data. Species distribution models showed that range filling (the ratio of realised vs. potential range size) was consistently higher for lentic than for lotic species. When using data from 1988 to model distributions in 2006, models consistently overpredicted the ranges of lotic species, and more strongly than for lentic species. These results confirm the proposed hypotheses, lending support to the assumption that habitat persistence shapes the evolution of dispersal. Further, we conclude that lentic species may be more successful in tracking climate change.



**Projections of shifts in tree species distributions: Assessing the influence of macro-climate and local processes***Eliane Meier*<sup>1</sup>, Niklaus Zimmermann<sup>1</sup><sup>1</sup> Land Use Dynamics, Swiss Federal Research Institute WSL

During Holocene, tree species ranges have adapted to changing climate conditions and are currently partly in equilibrium with today's climate. However, it is still unclear, whether tree species will be able to keep pace with the ongoing and likely accelerating shift in climate conditions. Here, we estimated the influence of changing abiotic macro-climate and (a)biotic local processes on shifts in large-scale tree species re-distributions. Therefore, we evaluated the difference between species distribution models (SDM) assuming "no migration", "unlimited migration", and "realistic migration" which implements a migration module in SDMs that include conceptually both biotic and abiotic constraints. For the this module, we combined dynamic migration simulations from a process model with SDMs and a GIS path cost analysis by varying environmental gradients, landscape fragmentation and species competition. Our results showed, that biotic interactions mainly limit species distributions towards favorable growing conditions, while climate was directly limiting primarily where biotic interactions were low. Landscape fragmentation was further strongly limiting the rate of migration. In conclusion, this may lead especially for late successional species to considerable time lags in range shifts and re-adjustment to new conditions during climate change. However, early successional species seem to be less affected by these constraints.



## The spread of *Fagus sylvatica* and *Picea abies* in southern Scandinavia during the late Holocene

Ronald Bialozyt<sup>1</sup>, Lee Bradley<sup>2</sup>, Richard H.W. Bradshaw<sup>2</sup>

<sup>1</sup> Conservation Biology, Philipps-University Marburg

<sup>2</sup> Department of Geography, University of Liverpool

During the recurrent glaciation of Europe, tree species had to adjust their ranges according to the changing environmental conditions. A discussion is still going on whether current ranges are purely defined by climatic conditions or if they are shaped by the order of dispersal events and are still in the process of colonisation. Many species have arrived in Scandinavia from the south via Denmark (here *Fagus sylvatica*) whereas other species originated from Russia (here *Picea abies*). Both species have a similar colonisation timespan and meet in Southern Sweden, where they compete for space. Pollen data of the immigration of the two species were available from several small forest hollow sites representing the colonisation route. We used a data-model comparison technique to investigate the resulting pattern of colonisation events of both species and compared it to the actual arrival times. By the combined use of long distance dispersal events and local dispersal we were able to generate quite comparable patterns. Parameter combinations were chosen giving the best match for both species. This indicates a speed of 100 m/yr for *F. sylvatica* and 250 m/yr for *P. abies*, which is in quite good accordance to other studies. Dispersal alone can explain the wavelike spread of *P. abies* but fails to explain the scattered pattern found for *F. sylvatica* in Scandinavia. At the small scale of stand establishment local climatic conditions or human activities might be more important.



**Abiotic and biotic drivers of change in species phenology of six selected tree species**

*Christine Römermann*<sup>1</sup>, Steve Higgins<sup>1</sup>, Manuela Müller<sup>1</sup>, Bob O'Hara<sup>2</sup>

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Climate change strongly effects species distributions. Species adapt to changes by e.g. prolonging their life-cycle. We are interested in the factors determining these changes: is it only the abiotic environments that lead to phenology changes, or do species eco-physiology determine the degree to which species react to climate change. We aim to unravel this question by analysing long-term phenological data from 6 selected tree species. We carried out detailed field studies at 10 different sites to measure two selected performance parameters for exactly those individuals that have been monitored during the last 60 years: photosynthetic capacity and specific leaf area (SLA) as a surrogate for growth rate. The results clearly showed that the biotic parameters clearly determined species phenology: the higher photosynthetic capacity and SLA of a species were the earlier started spring phenology, the later started autumn phenology and the higher was the increase in growing season length. Also temperature and CO<sub>2</sub> determined species phenology significantly. We concluded that the phenological responses of species are not only related to climate change but also to species' eco-physiology and performance. Species with higher photosynthetic capacities and higher growth rates profit more from climate change by extending their growing season and may hence be the winners in the context of climate change.



## SESSION 15 - LAND USE, BIODIVERSITY AND ECOSYSTEM PROCESSES

CONVENOR: SIMONE PFEIFFER, MARKUS FISCHER

### ORAL PRESENTATIONS:

#### **Goals, set-up, state and perspectives of the Biodiversity Exploratories**

*Simone Pfeiffer*<sup>1</sup>, Francois Buscot<sup>2</sup>, Sonja Gockel<sup>3</sup>, Martin Gorke<sup>1</sup>, Andreas Hemp<sup>1</sup>, Elisabeth K.V. Kalko<sup>4</sup>, Karl Eduard Linsenmair<sup>5</sup>, Swen Renner<sup>4</sup>, Ernst-Detlef Schulze<sup>6</sup>, Wolfgang W. Weisser<sup>3</sup>, Markus Fischer<sup>7</sup>

<sup>1</sup> University of Potsdam

<sup>2</sup> Helmholtz Centre for Environmental Research UFZ

<sup>3</sup> University of Jena, Institute of Ecology

<sup>4</sup> University of Ulm, Dep. Experimental Ecology

<sup>5</sup> University of Würzburg, T.-Boveri-Institute for Biosciences

<sup>6</sup> MPI BGC Jena

<sup>7</sup> Universities of Potsdam and Bern

The Biodiversity Exploratories have been established as research platform to study the complex relationships between land use changes, functional biodiversity and ecosystem processes. The DFG-funded long-term project works at three large-scale exploratories: the Biosphere Reserve Schorfheide-Chorin, the National Park Hainich and its surroundings, and the Biosphere Reserve Schwäbische Alb. This introductory talk will give a brief overview of the aims, established infrastructure and current activities of the exploratories. All research activities are carried out parallel to regular land management by land owners representing a gradient of land use intensities from near-natural to intensively managed landscapes. Up to now more than 300 scientists from more than 60 research groups conduct observations and experiments on different taxa, biodiversity levels and ecosystem processes. A data base specially designed by the data management group applies international standards of data upload, data storage and analysis. The web-based support given to coordinate field work activities and information transfer within the exploratory project enhances interdisciplinary cooperation and data syntheses of research groups across Germany.



**Functional diversity in grasslands of the Biodiversity Exploratory**

*Daniel Prati*<sup>1</sup>, Steffen Boch<sup>1</sup>, Jörg Müller<sup>2</sup>, Setphanie Socher<sup>1</sup>, Markus Fischer<sup>1</sup>

<sup>1</sup> Institute of Plant Sciences, University of Bern

<sup>2</sup> Institute of Biochemistry and Biology, University of Potsdam

Experiments showed that taxonomic and functional plant diversity affect ecosystem properties such as productivity. However, the relationship between taxonomic and functional diversity and their effect on ecosystems has seldom been studied in natural populations. To address this, we used vegetation and productivity data from the Biodiversity Exploratories. We assessed trait-based, functional diversity in grassland species by compiling information from data bases on traits related to productivity and traits related to reproduction. We then calculated recently developed indices of functional diversity, called f-richness (the size of a multidimensional trait-space of co-occurring species), f-evenness (the distribution of the species in this trait space), and f-divergence (cover-weighted deviation from the mean functional type). Communities with a higher number of plant species showed higher functional richness, however the strength of this relationship varied among regions. In addition, the number of plant species increased the functional evenness of communities, but without variation among regions. Structural equation models, however, showed that taxonomic diversity was a better predictor of productivity than any functional diversity index. This indicates that colonization of a species depends on the functional characteristics of those species in the resident community, but that the control of the resident communities over the immigrants varies regionally.



## **Response of vascular plant and lichen species richness to forest management**

*Steffen Boch*<sup>1</sup>, Daniel Prati<sup>1</sup>, Dominik Hessenmöller<sup>2</sup>, Markus Fischer<sup>1</sup>

<sup>1</sup> Institute of Plant Sciences, University of Bern, Switzerland

<sup>2</sup> Max-Planck-Institute for Biogeochemistry, Jena, Germany

**Premise and methods:** Here we present a comprehensive analysis of the effects of different management types, and site characteristics on vascular plant and lichen species richness. Twice a year in 2007 and 2008 we recorded vascular plants on 1,547 plots and lichens on 650 plots of 20 × 20 m as part of the Biodiversity Exploratory project.

**Key results:** On average vascular plant richness was higher in managed than in unmanaged forests while lichen richness did not differ. Increasing beech cover generally decreased vascular plant richness. However, richness of shade tolerant herbs was increased, and so was lichen richness in the most diverse region the Schwäbische Alb. Increasing coniferous tree cover generally decreased richness of shade tolerant herbs and lichens while richness of light demanding herb species increased. Our findings also indicate that forest management negatively affects both the typical composition of natural forest plant and lichen communities.

**Conclusions:** To enhance vascular plant and lichen species richness and maintain typical species composition in forests, in addition to meeting demands of wood production, we suggest to maintain management activities and promote mixed instead of pure beech or pure coniferous stands. Overall we conclude that total vascular plant richness is not suited as indicator of the conservation status of forests and recommend to rather monitor shade-tolerant herbs or lichens for these purposes.



**Chemical composition of community biomass reflects biodiversity patterns in Central European grasslands**

*Valentin H. Klaus*<sup>1</sup>, Kleinebecker Till<sup>1</sup>, Hölzel Norbert<sup>1</sup>, Socher Stephanie<sup>2</sup>, Boch Steffen<sup>2</sup>, Müller Jörg<sup>3</sup>, Prati Daniel<sup>2</sup>, Fischer Markus<sup>2</sup>

<sup>1</sup> University of Münster Institute for Landscape Ecology

<sup>2</sup> University of Bern Institute of Plant Sciences

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Preserving biodiversity in agricultural used landscapes is one of the most important tasks for nature conservation, today. The decline of species-rich semi-natural grasslands representing a hotspot of biodiversity in Central Europe is closely related to eutrophication due to an intensification of land use. Thus, information on the trophic status and the type of nutrient limitation of grassland stands is crucial for understanding patterns of plant species richness and driving forces for the loss of biodiversity in agriculturally managed grasslands. We analyzed trophic gradients in the aboveground biomass of 150 mesic grassland plots of the DFG-founded Biodiversity Exploratories ([www.biodiversity-exploratories.de](http://www.biodiversity-exploratories.de)) and related them to alpha diversity and threat status of plant species. Beside main nutrients such as N, P, K, Mg and Ca, fibre fractions (NDF, ADF, ADL) and ash content of biomass samples were determined. We found a strong negative relationship between plant diversity and biomass P, whereas biomass N showed less clear patterns. The N:P-ratio of the biomass exhibited a positive relationship of plant species richness with increasing P deficiency for semi-natural grasslands. A relatively wide N:P-ratio above the critical threshold of 10-13 seems to be mandatory for preserving grasslands of high nature conservation value.



**Diversity and species turnover of herbs and insects on plot level – Similarities and correlations across trophic levels**

*Martin Gossner*<sup>1</sup>, Stephan Getzin<sup>2</sup>, Kerstin Wiegand<sup>2</sup>, Wolfgang Weisser<sup>1</sup>

<sup>1</sup>Institute of Ecology, Friedrich-Schiller University Jena

<sup>2</sup>Department of Ecosystem Modelling, BÜSgen-Institut, Georg-August-University of Göttingen, Germany

Maintaining biodiversity and related functions and processes requires a better understanding of  $\alpha$ - and  $\beta$ -diversity changes across spatial scales. Consequently, studies on diversity patterns on different spatial scales have increased substantially during the last decade. Most of these studies focused on single taxa and it is less clear if patterns resemble across different trophic levels, not least because diversity of different trophic levels have only been rarely quantified on the same plots. We assessed diversity of plants and beetles on a total of 35 plots and 245 subplots in the Hainich-Dün and the Schwäbische Alb within the Biodiversity Exploratories project in the year 2008. We asked if there are similarities and dependencies in diversity patterns across trophic levels, by focusing mainly on plot and subplot levels. We found that  $\alpha$ -diversity was significantly lower and  $\beta$ -diversity on the exploratory scale significantly higher than expected by chance across all trophic levels. Differences among trophic levels were, however, found at intermediate spatial scales. Correlations of  $\alpha$ -diversity on plot and  $\beta$ -diversity on subplot level were weak. Surprisingly, species turnover of plants was less strongly correlated with herbivores than with higher trophic levels on among plot scale. Possible explanations for the observed patterns will be discussed.



**Herbivory on beech crowns**

*Esther Kowalski*<sup>1</sup>, Markus Lange<sup>1</sup>, Martin Gossner<sup>1</sup>, Patricia Geesink<sup>1</sup>, Wolfgang W. Weisser<sup>1</sup>

<sup>1</sup> Institut für Ökologie, Uni Jena

While land use is known to be a major driver of biodiversity loss, detailed studies on the effects of increasing land-use intensity on arthropod assemblages and related functions are still rare. We assessed herbivory of beech in unmanaged forests and differently managed forests including different developmental stages. The study was conducted in three regions of Germany within the biodiversity exploratory project: Schwäbische Alb, Hainich-Dün and Schorfheide-Chorin. Leaves were harvested in the southern, sun-exposed part of the upper canopy. Different damage types were distinguished: 1) leave area removed by external feeding insects, 2) damage induced by sucking insects, and the occurrence of 3) galls and 4) mines. The total amount of herbivory increased from North (Schorfheide-Chorin) to the South (Schwäbische Alb) of Germany. While leaf area loss and the occurrence of mines decreased from the Schwäbische Alb to the Hainich-Dün to Schorfheide-Chorin, the occurrence of gall inducing species and gall mites was smaller in the Schwäbisch Alb. Within the three regions only small differences in herbivory were observed between different land use types. Our results suggest that herbivory of beech might be not strongly affected by different forest management types. A more detailed quantification of land use intensity might reveal more subtle effects.



**Orientation in complex odorous environments: Does plant species diversity affect complexity of vegetation odor and arthropod orientation?**

Torsten Meiners<sup>1</sup>, Nicole Wäschke<sup>1</sup>, Monika Hilker<sup>1</sup>, Christine Herbst<sup>2</sup>, Elisabeth Obermaier<sup>2</sup>

<sup>1</sup> Applied Zoology/Ecology, Free University of Berlin

<sup>2</sup> University of Würzburg

Olfactory orientation by arthropods requires the ability to navigate through complex odor blends in natural habitats. Odor complexity may vary with the composition of vegetation. Here, we tested the hypotheses that (a) complexity of odors is dependent on plant species diversity and (b) olfactory orientation by arthropods is negatively affected by increasing plant species diversity. We used the monophagous weevil *Mecinus pascuorum*, its ubiquitous host plant plantain (*Plantago lanceolata*), and its larval parasitoid *Mesopolobus incultus* as a model system. Odor blends of 27 plots with different plant species diversity were analyzed by GC-MS. The plots were located in three study areas (<http://www.biodiversity-exploratories.de/>) with different land use gradients. The number and quantities of volatile compounds detected per plot were subjected to a diversity analysis, which resulted in a complex pattern of relationships between plant species diversity and odor diversity. Incidence of the weevil and the parasitoid corresponded positively with plant species diversity. Laboratory olfactometer studies revealed that weevil host plant finding was not impaired by odor complexity in the surroundings of the host plant. By contrast, the beetle's searching activity increased when odor blend complexity rose. Analysing relationships between plant species diversity, odor diversity, and olfactory orientation by arthropods can help to improve knowledge important for successful biological control.



**Processes at different spatial scales affect macro-invertebrate communities and their functional role in managed grasslands***Klaus Birkhofer<sup>1</sup>, Tim Diekötter<sup>1</sup>, Volkmar Wolters<sup>1</sup>*<sup>1</sup> Justus Liebig University Giessen

Ground-active macro-invertebrates are abundant components of animal communities in agricultural ecosystems, contributing to such important ecosystem services as pest control and decomposition of organic matter. The diversity, composition, density and biomass of invertebrate communities are affected by local environmental conditions, disturbances through management practices and by large scale heterogeneity of landscape composition or geographic gradients. We analyzed the explanatory power of such small and large scale processes for patterns in invertebrate communities from grassland plots and relate these results to functional changes in soil food-webs. While large scale processes explained a substantial amount of variation in community patterns, small scale predictors still added to the overall explanation after accounting for geographic gradients. We suggest that community patterns and to a lesser extent ecosystem functions are determined by large scale geographic differences. However, local conditions and management practices can significantly alter those properties on a smaller scale within geographic regions. Future research needs to address interactions between processes across multiple scales, to better predict consequences of agricultural intensification and land-use change on invertebrate communities.



**Lack of energetic equivalence in forest soil food webs**

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The abundance of animals in food webs depends on the amount of energy they need and what share they get. As abundance decreases with increasing body mass of the organism and metabolism as a measure of needed energy increases with increasing body mass of the organism, theory states that both effects should cancel and the energy a population uses per unit area should be independent of the body mass of the species. This pattern is referred to as the energetic equivalence rule. We investigated 52 forest soil food webs in a land-use gradient in the framework of the biodiversity exploratories. The abundance, body masses and standard metabolic rates of invertebrate species were measured. Based on these data we were able to calculate the energy that is used by the populations of the different species. In these forest soil food webs population-energy use increases with increasing body mass of the species which indicates that larger species are able to use energy more efficiently than smaller ones. This indicates that the energetic equivalence rule does not hold for forest soil food webs.



**Land use and host neighbor identities influence arbuscular mycorrhizal fungal community composition**

Kathryn Barto<sup>1</sup>, Christine Herbst<sup>2</sup>, Torsten Meiners<sup>3</sup>, Elisabeth Obermaier<sup>2</sup>, Nicole Waeschke<sup>3</sup>, Tesfaye Wubet<sup>4</sup>, Matthias Rillig<sup>1</sup>

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Arbuscular mycorrhizal fungi (AMF) are obligately symbiotic fungi that provide their plant hosts with nutrients and water in exchange for fixed carbon. AMF provide important ecosystem services such as soil aggregation, and contribute to structuring plant communities. We have previously shown that although total AMF abundance may be unaffected following land use intensification in grasslands, abundances of various AMF structures are differentially positively and negatively affected by land use intensification. Our objective was to determine whether these trends could be explained by changes in AMF community composition by quantifying AMF diversity in the same grassland system. We collected soils from 76 sites across a land use gradient within the German Biodiversity Exploratories, where land use consists of various combinations of fertilization, mowing, and grazing. Soil was collected from the root zones of *Plantago lanceolata* plants in order to minimize effects of host plant on AMF communities. We also identified all plant species within a 15 cm radius of the sampled *Plantago* plant. We measured AMF richness after T-RFLP analysis of DNA extracted from the soil and amplified with the AMF primers NS31/AM1. AMF richness and community composition were affected by land use and neighbor identity in complex ways. We discuss the implications of these effects for mycorrhizal dynamics in the field, and how they may explain the known effects of land use intensification on AMF abundance.



**Biodiversity in forests: A new assessment method using cost-effective remote sensing and fine-scale pattern analysis**

*Stephan Getzin*<sup>1</sup>, Kerstin Wiegand<sup>1</sup>

<sup>1</sup> Ecosystem Modelling, Faculty of Forest Sciences and Forest Ecology, University of Goettingen

The current dramatic loss of biodiversity is mainly ascribed to environmentally unsound land-use practices and habitat alterations under global change. If land-use managers shall be enabled to cope with the challenges from increasing natural hazards and to stop the loss of biodiversity, they will need time- and cost-effective assessment methods that ease their decision-making process. One such novel tool uses remotely-sensed spatial data acquisition based on high-resolution aerial images taken with unmanned air vehicles. The images can be used to extract the distribution, size, and shape complexity of forest gaps that act as structural filter of the incoming light signal and consequently, as determinant of light-dependent plant diversity in the understorey. Hence, the functional connectivity of plant species on the forest floor is directly dependent on the structural connectivity of canopy properties. Fine-scale pattern analysis of the spatial gap structures enables us to derive a complexity index that can be used to assess and forecast biodiversity in forests. This method is called a "coarse-filter approach" to conservation because instead of labour-intensive field work, one just needs to analyse the structural filter derived from aerial images and use it as surrogate for biodiversity. Our research was done in beech-dominated stands of the newly established "Biodiversity-Exploratories" in Germany.



## Grassland ecosystem multi-functionality governed by plant community diversity and composition

Gerlinde De Deyn<sup>1</sup>, Nick Ostle<sup>2</sup>, Richard Bardgett<sup>3</sup>

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We investigated how plant species richness, composition and soil fertility impact on the amount of carbon (C) and nitrogen (N) stored in vegetation, soil microbes and soil and on the loss of C and N from soil through leaching and on ecosystem CO<sub>2</sub> exchange rates. We established grassland plant communities of 1, 2, 3 or 6 species and of 1, 2 or 3 functional groups selected from a pool of 6 species and 3 functional groups (legumes, forbs and C3 grasses) and grew them in low or high fertility soil. The amount of C and N stored in vegetation (aboveground and belowground) and soil microbes increased with larger plant species and functional group richness and with soil fertility. Greater plant species richness also reduced the loss of water and dissolved N via soil leaching, but also the abundance of specific species significantly affected N loss: increasing or decreasing it depending on species identity. The amount of C and N stored in soil at the end of the experiment differed between plant communities and was not related to the richness of plant species or functional groups, but specifically due to the presence (*T. repens*) or abundance (*L. corniculatus*) of legume species. Our findings that different key plant species promote C and N storage in vegetation and soil, and the suppression of soil leaching indicate that the maintenance of plant diversity is important to sustain the multiple functions grasslands provide.



**Frugivore diversity and seed dispersal of *Sorbus aucuparia* in different land-use types**

Jörg Albrecht<sup>1</sup>, Eike Lena Neuschulz<sup>1</sup>, Nina Farwig<sup>1</sup>

<sup>1</sup>Dept. of Ecology - Conservation Ecology, Philipps-Universität Marburg

Land-use intensification endangers the maintenance of biodiversity and ecosystem processes such as seed dispersal. The mutualism between frugivorous birds and plants is important for plant regeneration processes and the persistence of plant species as well as the maintenance of frugivore communities. We quantified frugivore diversity and fruit removal of 18 *Sorbus aucuparia* trees along a human land-use gradient ranging from structurally complex forest sites and semi-natural habitats within an agricultural matrix to highly modified habitats in gardens within rural settlements. Here we show that increasing land-use intensity had no effect on species richness, but negatively affected frugivore abundance, visitation- and fruit removal rates. Moreover, with increasing land-use intensity species composition shifted from specialist to generalist species, whereby generalists were less effective in their function as seed dispersers than specialists. These changes in species composition in response to increasing land-use intensity indicate that species within frugivore communities differ in their sensitivity to land-use change. Nevertheless, redundancy and niche complementarity seem to cause stability in fruit removal rates despite changes in the composition of communities. However, as generalist species are less effective in their function as seed dispersers, effective dispersal of plant species may be impaired in the long-term.



**Impact of land use and climate on the phylogenetic and functional diversity of bats (Chiroptera)**

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When it comes to evaluation of biodiversity, growing attention, besides on species richness, is put on phylogenetic and functional diversity. We investigated the influence of climate and land use on these diversity measures in Bavarian bat communities. Therefore we employed 2 indices of phylogenetic diversity ( $\Delta+$  and  $\Lambda+$ ) and 4 indices of functional diversity (FRic, FEve, FDis, FDiv). The records of the 22 Bavarian bat species refer to presence/absence data from the bat atlas of the Bavarian Environmental Authority in Germany. For calculating the phylogenetic diversity we used a molecular phylogeny that we derived from sequences of the mitochondrial protein-coding gene *nd1*. The functional diversity indices base upon five traits that can be connected to resource partitioning in bats. The effect of land use types from CORINE and climate variables from the WorldClim database were measured in multiple linear regression models. Our results demonstrate a minor effect of climate on phylogenetic, but not on functional diversity. Urban environments were detected to be beneficial for functional diversity, while not effecting phylogenetic diversity indices. While broadleaved forest and crop land dominated environments favoured functional diversity, phylogenetic diversity increased with coniferous forests and meadows. This last effect was not evident for the species richness. The study underlines the importance of assessing different aspects of biodiversity to get deeper information on how communities assemble.



POSTER PRESENTATIONS:**Analysing trophic links in the litter food web of temperate forests: A molecular approach***Bernhard Eitzinger*<sup>1</sup>, Stefan Scheu<sup>1</sup><sup>1</sup> J.F. Blumenbach Institute of Zoology and Anthropology, University of Goettingen

Knowledge on trophic links in food webs is essential if we are to understand community dynamics and functioning. The functioning of terrestrial ecosystems fundamentally relies on the decomposer food web which until today is little understood. Feeding ecology and prey choice of litter and soil invertebrate species are difficult to assess as they live in an opaque habitat, are fluid feeders or comprise minute organism. In the framework of the Biodiversity Exploratories, an integrated large scale ecological project funded by the German Research Foundation (DFG), we investigate trophic links in soil and litter dwelling invertebrate communities of temperate forests. Using molecular gut content analysis, a sensitive PCR based technique, we trace trophic links between generalist predators and their extra- and intraguild prey and evaluate the impact of predators on prey species. The focal study site is located in the national park Hainich (Thuringia, Germany) and encompasses four areas of unmanaged beech forests (each 100× 100m). Predators were collected by litter sieving on four dates in October 2009 and June 2010. To assess the prey spectrum and prey densities soil cores were taken and extracted by heat. Catches were dominated by lithobiid centipedes, linyphiid spiders and staphylinid beetles. Collembola and earthworms were identified as most important extraguild prey. Species specific molecular markers suggest that these prey groups account for large part of the diet of lithobiid centipedes.



**Reproductive mode and community structure of oribatid mites along a forest land use gradient**

Georgia Erdmann<sup>1</sup>, Mark Maraun<sup>1</sup>

<sup>1</sup> Abt. Zoologie, Universität Göttingen

About 10 % of oribatid mite species are thelytokous. In soil 30-80 % of oribatid mite individuals reproduce thelytokous. These proportions are high in contrast to other animal taxa. The maintenance of parthenogenetic reproduction is a riddle for evolutionary science since parthenogenetic reproduction is regarded as an evolutionary dead end. A plenty of theories exist which try to explain under which conditions parthenogenetic reproduction is beneficial and will be maintained. In this study the Resource-of-Sex-Theory of Scheu and Drossel (2007) was tested. The thesis states that sexual reproduction prevails in an environment of structured resources in short supply. The hypothesis was tested in temperate forest ecosystems. Density, community structure and reproductive mode of oribatid mites in beech forests of three different age classes (managed 30y, managed, 70y and unmanaged 120y) and coniferous forests of one age class (70y) were analyzed in 3 areas in Germany (Hainich-Dün, Schorfheide-Chorin, Schwäbische Alb). The density of oribatid mites was used as a measure for resource density. The highest densities of 260000 individuals per m<sup>2</sup> were found in coniferous forests and the lowest of 8000 individuals per m<sup>2</sup> in unmanaged beech forests. With increasing density the percentage of parthenogenetic oribatid mites increased from 40 to 80 % which supports the Resource Theory of Sex.



**Trophic interactions in a grassland management experiment (GRASSMAN)**

Georg Everwand<sup>1</sup>, Christoph Scherber<sup>1</sup>, Teja Tscharntke<sup>1</sup>

<sup>1</sup>Agrarökologie, Universität Göttingen

Currently, too little is known about important ecological functions and the economic value of ecosystem services associated with agriculture and forestry (Balmford et al. 2002), such as insect pollination or natural biological pest control by parasitoid wasps. The GRASSMAN-Experiment was established in 2008 as a long-term field study in a semi-natural, moderately species-rich grassland site north of Göttingen, consisting of 3 diversity treatments in 4 management levels with 6 replicates, in total, 72 plots (15 x 15 m), using a three-factorial experimental design. The three different levels of species richness were established by applying specific herbicides to simulate loss of herbaceous species as well as a general species loss in a removal experiment. Results of other recent removal experiments suggest that they are useful and realistic for understanding the ecosystem effects of local, non random extinctions, changes in the natural abundance of species, and complex interspecific interactions, but can result in changes of the plant community (Diaz et al. 2003).

Hypotheses:

1. Increasing management intensity affects invertebrates diversity and abundance.
2. Lower plant diversity decreases insect species richness.
3. Management intensity and plant species composition causes changes in trophic interactions, e.g. herbivory and parasitism rates.

First results indicate strong effect of plant diversity and composition on insect communities.



## **Soil macrofauna diversity in managed grasslands of the DFG Biodiversity Exploratories**

*Janine Groh*<sup>1</sup>, Klaus Birkhofer<sup>1</sup>, Tim Diekötter<sup>1</sup>, Volkmar Wolters<sup>1</sup>

<sup>1</sup> Department of Animal Ecology, JLU Giessen

Soil macrofauna diversity plays an important role in maintaining soil quality and thereby contributes to sustainable agricultural production. We investigated effects of management practices on soil macro-invertebrate communities in grasslands in the DFG Biodiversity Exploratories. We hypothesised that small scale differences in management, abiotic conditions or vegetation have a higher explanatory power for the abundance and species richness of relatively immobile soil animals compared to larger scale differences in landscape structure, soil texture or elevation (as proxy for climate). Effects of abiotic and biotic factors on myriapods and earthworms were analyzed using distance-based redundancy analyses. Local characteristics, such as management practices, water holding capacity or soil pH contributed significantly to the partitioning of variation in abundance, species richness and community composition. However, large scale differences in elevation and soil texture were better predictors of myriapod and earthworm community composition, myriapod abundance and diversity than small scale factors. Our results highlight the need to consider large-scale effects in studies that generalize about management effects on biodiversity, even for soil taxa with limited mobility.



## Management and plant-species richness effects on P cycling in grasslands and forests

Yvonne Oelmann<sup>1</sup>, Fabian Alt<sup>1</sup>, Martin M. Gossner<sup>2</sup>, Norbert Hölzel<sup>3</sup>, Valentin Klaus<sup>3</sup>, Till Kleinebecker<sup>3</sup>, Wolfgang Weisser<sup>2</sup>, Wolfgang Wilcke<sup>4</sup>

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P is an essential nutrient but fertilizer-P resources are expected to be exhausted posing problems to adequate P nutrition in managed ecosystems.

Our objective was to study the influence of management and plant species richness on P availability in soil and N:P ratios in grassland and forest plots of the Biodiversity Exploratory Swabian Alb.

If N:P ratios above 20 indicate P limitation, plant growth in 74% of the forests was limited by P. Site-specific P availability in soil was most important in determining the type of nutrient limitation. Since N:P ratios were below 20 without exception, we found no indication of exclusive P-limitation in grasslands. Grazed pastures were characterized by lowest  $\text{NaHCO}_3\text{-P}_i$  concentrations in soil and highest N:P ratios compared to mown pastures and meadows. Plant species richness was negatively related to  $\text{NaHCO}_3\text{-P}_i$  concentrations in soil also if land use was statistically accounted for. Plant-species richness was positively related to the exploitation of P resources in soil. If plant-species richness initially established according to P availability in soil, increased exploitation of P resources in diverse grasslands will steepen the slope of the relationship between plant-species richness and plant-available P concentrations in soil.

We conclude that changes in management measures that increase plant-species richness in formerly low-diverse ecosystems would have the potential to tighten P cycling and thus, counteract the predicted exhaustion of fertilizer-P resources.



**Spider diversity in grasslands of the DFG Biodiversity Exploratories is affected at local, landscape and regional spatial scales**

Nico Radermacher<sup>1</sup>, Tim Diekötter<sup>1</sup>, Volkmar Wolters<sup>1</sup>, Klaus Birkhofer<sup>1</sup>

<sup>1</sup> JLU Giessen

Spiders are among the most abundant generalist predators in terrestrial habitats and may limit herbivore and decomposer population growth. We studied communities of ground-running spiders in differently managed grassland plots in the DFG Biodiversity Exploratories to identify local, landscape and regional effects on spider diversity. Vegetation cover was negatively correlated to the activity density of spiders, while the diversity decreased with increasing proportions of forest in a 1000 m radius around plots. Species composition was predicted by elevation, the number of cuttings and water holding capacity, with wolf spiders preferring grassland plots in lower and crab spider species those in higher altitudes. Functional group composition was explained by the number of cuttings, plot size and grazing pressure, as wandering sheet/tangle web weavers were more dominant in more frequently cut grasslands. We conclude that grassland management can be adapted to conserve spider diversity *per se*, but that the analyzed factors act differently on overall species richness or species richness within functional groups. Thus, to promote specific ecosystem services in agroecosystems, e.g. control of aphid pests, targeting selected functional groups may be most effective but may come at the cost of not conserving highest levels of overall spider diversity.



## SESSION 16 - BIODIVERSITY IN MAN-MADE HABITATS

CONVENOR: BRUNO BAUR, MARTIN DIETERICH

### ORAL PRESENTATIONS:

#### **Effects of management abandonment on microtopography and plant traits in natural fen meadows**

*Wout Opdekamp*<sup>1</sup>, Olivier Beauchard<sup>1</sup>, Hans Backx<sup>1</sup>, Tom Cox<sup>1</sup>, Rudy van Diggelen<sup>1</sup>, Patrick Meire<sup>1</sup>

<sup>1</sup> Ecosystem Management Research Group, University of Antwerp

Most European grasslands with high natural values depend on extensive management to maintain their diversity. Abandonment of this management would result in a secondary succession towards woodland. Along 4 transects in managed and abandonment (>20 years) fen meadows in Biebrza National Park (NE-Poland) we measured microtopography, standing crop, light distribution, distance to the river and species composition. Traits related to persistence and establishment were selected from existing databases (LEDA, BIOLFLOR, ...). The relationship between plot characteristics and species traits was analysed using concordance analysis (Lafosse & Hanafi 1997). Unmanaged sites were associated with increased tussock size, higher vegetation, lowered light availability, ... while managed sites showed high moss abundances. From a trait point of view, taller species with an erect stem, very limited lateral spread and lower light requirements were relatively abundant in unmanaged sites while in managed sites smaller species with more lateral spread and higher light requirements were more abundant. To conclude, we state that management cessation clearly resulted in a modification of the physical environment. However, in the considered time period, this resulted only in a small difference in species richness but it caused shifts in species composition and hence trait distribution. Trait-attributes linked to persistence and competitive ability show a relatively higher representation in unmanaged plots.



**Species richness of multiple taxonomic groups along a successional gradient in a coastal Baltic heathland**

Jasmin Mantilla-Contreras<sup>1</sup>, Jens Schirmel<sup>2</sup>, Irmgard Blindow<sup>2</sup>, Stefen Zerbe<sup>3</sup>

<sup>1</sup> Institute of Botany and Landscape Ecology, University of Greifswald

<sup>2</sup> Biological Station of Hiddensee, University of Greifswald

<sup>3</sup> Faculty of Science and Technology, Free University of Bozen

For the conservation of biodiversity, heathlands have an important function in Europe. Due to land use changes, these formerly widespread habitats are currently restricted to small and isolated remnants. Without management, heathland vegetation undergoes succession. In addition, the increasing amount of atmospheric nitrogen deposition has resulted in an encroachment of grasses. We analysed the effects of succession and grass encroachment on the diversity of five taxonomic groups (plants, ground beetles, spiders, butterflies and grasshoppers) along a successional gradient (five stages: grey dunes, dwarf-shrub heath, grassy heath, heath with shrubs, birch forest) in a coastal heathland on the island of Hiddensee, Germany.

Plant species richness was highest in grey dunes and birch forests, while the highest species number of grasshoppers and butterflies occurred in the heaths with shrubs. For spiders and ground beetles, species richness was very similar in all successional stages, but species composition changed remarkably. Threatened and specialised species were mainly restricted to young successional stages such as grey dunes and dwarf-shrub heaths. Total biodiversity in the study area was high due to the occurrence of different successional stages side by side. Conservation practices should therefore aim at maintaining the typical heterogeneous heathland mosaic with open grey dunes and *Calluna* stands combined with older successional stages.



**Effects of shrub encroachment in dry grasslands - A case study with regard to biodiversity, environmental changes and its potential use as renewable energy**

Dorothea Pietzsch<sup>1</sup>, Jasmin Mantilla-Contreras<sup>1</sup>, Jens Schirmel<sup>2</sup>, Kerrin Müller<sup>2</sup>, Wiebke Retzlaff<sup>3</sup>, Christoph Leuschner<sup>3</sup>, Ulrich Hampicke<sup>3</sup>, Irmgard Blindow<sup>2</sup>

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Dry grasslands represent unique ecosystems that are known for their high biodiversity. Land use and land cover changes have led to an alarming decline of dry grasslands in Europe. Shrub encroachment is a major problem in unmanaged or incorrectly managed grasslands, and affects not only the flora and fauna but leads also to environmental changes such as increasing soil nutrients contents. In an integrated study, we investigate the effects of shrub encroachment on vegetation, ground beetles, and environmental parameters in dry grasslands on the island of Hiddensee, Germany during the summer of 2010. Dry grasslands are still widespread on the island, but endangered due to an ongoing shrub encroachment. We focused on three common shrub species, namely *Hippophae rhamnoides*, *Cytisus scoparius* and *Crataegus spp.* First results of the effects of single shrub species on microclimate, plant and ground beetle richness, soil nutrient content and vegetation are presented. We further calculated the costs of different management methods and discuss alternative strategies (e.g. use of shrub material as renewable energy) for the maintenance and preservation of dry open grassland habitats.



**How does secondary succession affect the biocoenosis of mountain hay meadows?**

*Ira Heilburg*<sup>1</sup>, *Silvana Siehoff*<sup>1</sup>, *Gottfried Lennartz*<sup>2</sup>, *Martina Roß-Nickoll*<sup>1</sup>

<sup>1</sup> Institut für Umweltforschung, RWTH Aachen University

<sup>2</sup> Gaiac - Forschungsinstitut für Ökosystemanalyse und -bewertung e.V. , RWTH Aachen University

Species richness of semi-natural grassland ecosystems originates from the interplay of natural factors and extensiv anthropogenic landuse. Intensification and abandonment - both consequences of the structural change in agriculture - cause degradation and losses of grassland communities. Aim of this study was to characterize the species composition of the phyto-, carabido- and araneocoenosis of mountain hay meadows (Geranio-Trisetetum) in the Eifel National Park and to investigate their possible change in the course of secondary succession. The vegetation was surveyed with the Braun-Blanquet method. Faunistic data were collected over one growing season (2008) by using pitfall traps. According to the biocoenological approach, the pitfall traps were installed within phytosociological records.



**Effect of grassland fragmentation on genetic diversity: Delayed response in a plant-pollinator system**

Bruno Baur<sup>1</sup>, Hans-Peter Rusterholz<sup>1</sup>

<sup>1</sup> Department of Environmental Sciences, University of Basel

The fragmentation of natural habitat is considered to be a major threat to biodiversity. Decreasing habitat quality and quantity caused by fragmentation may lead to a disruption of plant-pollinator interactions and to a reduction in sexual reproduction in plant species. We conducted a 6-year field experiment to investigate the effects of small-scale fragmentation on plant-pollinator interactions and genetic diversity in the self-compatible *Betonica officinalis*. We examined the abundance and composition of pollinators, the foraging behaviour of bumblebees and the performance, outcrossing rate and genetic diversity of *B. officinalis* after 2 and 6 years in experimentally fragmented nutrient-poor, calcareous grassland in the northern Swiss Jura mountains. Experimental grassland fragmentation altered the composition of *B. officinalis* pollinators and reduced their flower visitation rate. Furthermore, the foraging behaviour of bumblebees was changed in the fragments. The outcrossing frequency of *B. officinalis* growing in fragments was reduced by 15% after 2 years and by 31% after 6 years of experimental fragmentation. This resulted in a significant reduction of the genetic diversity in seedlings emerging in fragments after 6 years. Our study shows that small-scale habitat fragmentation can disturb the interaction between *B. officinalis* and pollinators resulting in a reduced outcrossing frequency and genetic diversity in plants growing in fragments. However, the response to fragmentation was considerably delayed.



**Land use change in Stockholm archipelago and the effect on grassland plant diversity and richness**

*Josefine Reimark*<sup>1</sup>, Sara Cousins<sup>1</sup>

<sup>1</sup> Dep. of Physical Geography and Quaternary Geology, Stockholm University

200 years of land use change and the relationship to present plant species richness was investigated on island in the Stockholm archipelago. The aim with the study is to explore how land use over time, especially grazing, affects richness today and in the future. The study area encompasses a rural landscape with long continuity of farming where on three of the larger islands four farmers are still active. It also includes the smaller so-called satellite islands belonging to the farms. Land cover and land use change was interpreted from maps and aerial photos creating four time-layers in a GIS (17-1800s, 1900s, 1950es and present-day). In 2009 plant species occurrence was measured on 36 islands with focus on grazed and non-grazed fields and surrounding forests. In each habitat plant occurrence was measured in 10 plots (1m<sup>2</sup>) as well as total species occurrence. The most substantial changes in land cover are a decline in semi-open forest, meadows and mid-field islets. Instead there is an increase in the number of houses and gardens and dense forest. 100 years ago there were 25 farms in the area. Grazed open habitat was most species rich with a mean of 15 species /m<sup>2</sup>. The results show that grazing is an essential part in maintaining species richness. However, by keeping areas open by clearing trees and shrubs can also slow down the extinction of grassland plant species.



**The impact of land-use on the water balance of moderately species-rich grassland**

Laura Rose<sup>1</sup>, Heinz Coners<sup>1</sup>, Christoph Leuschner<sup>1</sup>

<sup>1</sup> Plant ecology, Georg-August University of Göttingen

Agricultural grasslands are amongst the most species-rich ecosystems in Europe. In the last decades, land-use intensification led to changes in structure and plant diversity in those habitats. While much research focused on the impact of land-use changes on floral biodiversity little is known about the response of important ecosystem functions (e.g., nutrient retention and water cycling). We conducted a full factorial grassland management experiment including two cutting frequencies (one cutting / three cuttings per year) and two fertilization treatments (non fertilized / N-fertilized) at a moderate species-rich grassland site in the Solling Mountains, Germany. Evapotranspiration and infiltration were measured in the growing season 2009 with small, weighable lysimeters comprising undisturbed soil and vegetation. Additionally, above and belowground biomass, WUE, root length density, plant biodiversity, and climatic factors were monitored.

Evapotranspiration of all treatments was mostly determined by VPD, while the amount of infiltration depended on precipitation. Fertilization led to increased evapotranspiration and decreased infiltration values, while cutting frequency had no significant impact on the water balance. Main differences between the treatments were increased WUEs as well as increased aboveground biomass production in fertilized plots. Aboveground biomass production was positively correlated with evapotranspiration, whereas infiltration was negatively correlated with evapotranspiration.



## **Changes in species richness and composition in German grasslands over the last decades – The role of nitrogen deposition and other explanatory variables**

*Martin Diekmann*<sup>1</sup>, *Cecilia Duprè*<sup>1</sup>

<sup>1</sup> Institute of Ecology, University of Bremen

Nitrogen (N) deposition has become a major threat to biodiversity. The effects of N deposition on plant species richness and composition have been studied mainly by means of controlled experiments and spatial comparisons along deposition gradients, whereas time series analyses of plot data are as yet rare. Here we compare vegetation data from northern Germany sampled over several decades, focusing on semi-natural, unfertilized grasslands on acidic and calcareous soils. In total more than 2 000 vegetation quadrats were compiled. Species richness and species diversity were related to various environmental variables including geographical location, topography, climate, soil and an estimate of the cumulative amount of nitrogen deposition over time (based on present-day modelling data). The results of our analyses showed considerable differences in vegetation dynamics between the two grassland types. In the acidic grasslands, species composition and richness clearly have changed over time, and the cumulative N deposition had a strong negative effect on the total number of species and particularly on the number of forb species. In contrast, in the calcareous grasslands, the changes in vegetation and species diversity were much less pronounced and mainly confined to the most mesic sites. However, there was a change in the proportions of different life forms and in the frequency of many species also in the calcareous grasslands.



## Effects of functional grassland diversity and different management intensities on net N mineralisation

Ina Hoefl<sup>1</sup>, Edzo Veldkamp<sup>1</sup>, Nicole Wrage<sup>2</sup>

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From recent grassland studies it is known that a higher plant diversity can correlate positively with plant productivity and plant nitrogen (N) uptake. To quantify net N mineralisation from naturally species-rich grassland (controls), monocotyl-dominated and dicotyl-dominated grassland, we established a replicated field experiment on old agricultural grassland in the Solling uplands (Lower Saxony, Germany). Differences in plant functional groups were influenced by herbicide treatments. Additionally, two contrasting N fertilizer treatments (0 versus 180 kg N ha<sup>-1</sup> yr<sup>-1</sup>) and two utilization intensities (one versus three cuts per year) were set up. Net N mineralisation was measured five times using buried bag-method in the vegetation period 2009. Soil samples were incubated for 10 days and extracted in K<sub>2</sub>SO<sub>4</sub> directly in the field. Net N mineralisation rates increased significantly in the order monocotyl-dominated < dicotyl-dominated < control treatments ( $P = 0.001$ ). Fertilizer application did affect net N mineralisation significantly with higher rates in fertilized treatments ( $P = 0.001$ ). Additionally, utilization intensities showed significant effects on net N mineralisation rates, with higher results in treatments with three cuts per year ( $P = 0.05$ ). Our results demonstrate that net N mineralisation rates in grassland were influenced by functional grassland diversity and were driven by agricultural management activities.



## Explaining grassland biomass– The importance of biodiversity and climate changes with fertilization and mowing frequency

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<sup>4</sup> Department Silviculture and Forest Ecology of the Temperate Zones; Georg-August University Göttingen

Climate and biodiversity patterns influence grassland biomass, but up to now no study quantified their relative importance in relation to management. We investigated the relative effect of climate and biodiversity on biomass of differently managed grassland plots in Germany. Biomass and vegetation composition was monitored over the last 37 years at five different mowing regimes, each with and without fertilization. We calculated presence-absence based indices of species and functional richness, and the abundance weighted indices of species evenness and functional divergence as measures for biodiversity. The results revealed that within each fertilization treatment, grassland biomass was highest at intermediate mowing frequencies. At the most intensive disturbance regimes (4 and 8 times mowing) species and functional richness were most important to explain biomass, pointing to the importance of the local species pool. In contrast, species evenness, temperature and precipitation were most important at low management intensities; at such conditions low evenness values point to the dominance of competitors. Functional divergence was most important on frequently mown fertilized plots, again referring to filters for highly specialized species, but combined with dominance structures also referring to mechanisms of co-existence. Conclusion: Climate and biodiversity both influence annual grassland biomass, but their importance changes with nutrient status and management frequency.



**Stability of components of land use intensity**

Lars W. Clement<sup>1</sup>, Jan Bengtsson<sup>2</sup>, Piotr Ceryngier<sup>3</sup>, Sebastian Hänke<sup>4</sup>, Violetta Hawro<sup>3</sup>, Teja Tschardt<sup>4</sup>, Camilla Winqvist<sup>2</sup>, Wolfgang W. Weisser<sup>1</sup>

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Recently, there has been increased interest in the effects of agricultural intensification (AI) on biodiversity and ecosystem functioning. For comparative studies, it is necessary to choose farms differing in land use intensity by using past management information. There is a lag of information, however, on the stability and predictability of different components of AI over time. As part of the ESF-funded AGRIPOPEs project, we investigated farms in 3 European countries over 2 years. We obtained measures of AI in both years and asked which components show variability between farms and a higher correlation between years. We also tested the usefulness of 3 indices of AI. There was a high variation within the stability of the different components of AI. The coefficients of determination varied from  $R^2=1$  (farm type) to non significant correlations (e.g. ingredients of insecticides). Three different AI-indices were calculated based on (1) the literature, (2) the three measures of AI with the highest product of CV and  $R^2$  and, (3) the three measures of AI most predictive for biological pest control. All three indices were highly correlated over time, negatively correlated to the number of weed species in the field in 2007, but did not correlate with the carabid diversity in 2008. They vary in their prediction of yield per farm in future. We conclude that at the farm level measures of land use intensity are variable over time and should be selected cautiously to predict AI in future.



## **Biodiversity and the mitigation of climate change through bioenergy: Impacts of increased maize cultivation on abundance of farmland wildlife**

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<sup>3</sup> Department for Land Use Systems, Leibniz Centre for Agricultural Landscape Research (ZALF), Müncheberg, Germany

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An increasing promotion of renewable energies is expected to increase the number of biogas plants and stimulate energy crop cultivation (e.g. maize) in Germany. We developed six scenarios and simulated the responses of six farmland wildlife species with the spatially explicit, agent based model system ALMaSS. The scenarios differed in the composition and the spatial configuration of arable crops. We implemented landscapes with crop rotations with approximately 15 % and 30 % additional maize. Biogas maize farms were either randomly distributed or within small or large aggregation clusters. The animal species investigated were the skylark (*Alauda arvensis*), the grey partridge (*Perdix perdix*), the European brown hare (*Lepus europaeus*), the field vole (*Microtus agrestis*), a linyphiid spider (*Erigone atra*) and a beetle (*Bembidion lampros*). The changes in crop composition had a negative effect on the population size of skylark, partridge and hare, a positive effect on the population size of spider and beetle and no effect on the population size of vole. An aggregated cultivation of maize amplified these effects, although not to the same degree in all species. Comparing species responses in differently structured landscapes, we found that a generalization of our results is possible. Our work suggests that with the compliance to some recommendations, negative effects of biogas related land use change on the populations of the six representative farmland species can largely be avoided.



**Indirect land-use change through bioenergyproduction – A model analysis**

*Henning Nolzen*<sup>1,2</sup>, Hanna Weise<sup>2</sup>, Erik Gawel<sup>3</sup>, Karin Frank<sup>1,2</sup>

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The increased production of bioenergy is a strategy to respond to multiple future challenges: rising global energy demand, decreasing supply of fossil fuels, climate change, and creation of new options of added value in agricultural regions. However increased demand for bioenergy can trigger changes in land-use associated with negative environmental effects (water, soil, biodiversity, climate balance). For the sustainable management of bioenergy production, it is important to consider this land-use change and its environmental effects in the assessment. A special challenge is to deal with the so-called indirect land-use change (ILUC). It arises when land-uses like food production are replaced by bioenergy crop cultivation and escape into other areas.

An agent-based modelling approach is used to analyze the conditions under which and to what extent indirect land-use change (ILUC) arises in connection with the production of bioenergy. Furthermore, various control approaches are studied in their effectiveness for dealing with ILUC. Therefore a grid-based model is developed, in which land owners decide based on markets and policy on the retention or replacement of land-use options in their cells on the grid. Their decision is based on profit maximization. The agents can choose between different forms of land-use: cultivation of energy crops, grazing and, under certain circumstances also fallow land or forest farming. First results and examples of the potential of the model approach will be presented.



POSTER PRESENTATIONS:**Nitrogen loss pathways and fluxes in sloping cropland in China**

Jessica Bergmann<sup>1</sup>, Klaus Butterbach-Bahl<sup>1</sup>, Minghua Zhou<sup>2</sup>, Tao Wang<sup>2</sup>, Bo Zhu<sup>2</sup>, Nicolas Brüggemann<sup>1</sup>

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In China, large amounts of nitrogen are lost from agroecosystems in the form of  $\text{NH}_3$ ,  $\text{N}_2\text{O}$ ,  $\text{NO}_x$ , nitrate leaching and particle-bound nitrogen in run-off due to excess nitrogen fertilizer use. A  $^{15}\text{N}$  tracer experiment on nitrogen loss pathways and for establishing a full N balance was conducted on lysimeter fields with a wheat-maize rotation system and an annual N fertilizer application rate of  $280 \text{ kg N ha}^{-1}$  at the Yanting Agro-ecological Experimental Station of Purple Soil, Sichuan province, China. The experiment was set up in October 2009 with the onset of the wheat season.  $\text{NH}_4\text{HCO}_3$  as mineral N fertilizer and pig manure as organic fertilizer were labeled with  $(^{15}\text{NH}_4)_2\text{SO}_4$  up to a  $^{15}\text{N}$  content of  $\sim 0,476$  at%. Measurements were carried out for 5 treatments (N, NPK, organic manure (OM), NPK 3-layer, control). Special attention was paid to measuring gaseous losses of  $\text{N}_2\text{O}$  and  $\text{NH}_3$  during the post-fertilization period. In addition, a focus was laid on organic and inorganic soil N dynamics as well as microbial mineralisation and nitrification. Quantification of N leaching losses started at the onset of the rainy season in June 2010. First results are presented for gaseous losses of  $\text{N}_2\text{O}$ . The soil  $\text{N}_2\text{O}$  emissions across all plots ranged from  $-4$  to  $1165 \mu\text{g N m}^{-2} \text{ h}^{-1}$  with the highest values measured for OM. The  $^{15}\text{N}$  enrichment of  $\text{N}_2\text{O}$  across all fields ranged from a  $\delta^{15}\text{N}$  of 3.3 to 106.2‰, with OM showing the highest  $\delta^{15}\text{N}$ .



**Ground beetle biodiversity (Coleoptera: Carabidae) at an arable farm under conversion to organic cultivation in Eastern Austria**

*Patrick Hann*<sup>1</sup>, Bernhard Kromp<sup>1</sup>, Frauenschuh Eva-Maria

<sup>1</sup> Bio Forschung Austria

Intensive conventional agriculture is a major threat to biodiversity of agricultural ecosystems due to landscape clearing, monotonous crop rotations and the use of synthetic fertilizers and pesticides. Organic farming is considered to enhance the biodiversity of formerly conventionally managed fields by converting to diverse crop rotations, organic fertilizers and green manuring as well as excluding synthetic pesticides. Additionally, biodiversity might be augmented by establishing uncultivated landscape elements. In order to test these assumptions under the dry-warm conditions of Eastern Lower Austria, carabids have been monitored at an arable farm under conversion to organic cultivation. In 2003, 2004, 2007 and 2008, carabid beetles were collected with pitfall traps in 21 sampling lines with four traps each. The current results showed no general increase of species richness over the years, but impacts of weather and crop on carabid assemblages. The highest species richness (24 spp.) was found in organically cultivated alfalfa, the lowest (6 spp.) in a control field with conventionally managed sugar beet. Specialised species of the landscape elements contributed towards the high carabid diversity (up to now 95 spp.) of xero-thermophilous field species. A correspondence analysis of carabid catches separated the uncultivated landscape elements from the cultivated fields, emphasizing the significance of hedges and flowering strips for biodiversity. Monitoring is still ongoing.



**Plant functional traits are responsive to gradients in land use intensity***Patrick Lienin*<sup>1</sup>, Michael Kleyer<sup>1</sup><sup>1</sup> Landscape Ecology, University of Oldenburg

Relationships between functional leaf traits across large sets of plant species emphasized the existence of a major axis describing a trade-off between rapid acquisition and conservation of resources forming the so-called “leaf economics spectrum”. To determine the main environmental drivers of specialization in an agricultural landscape, this study was conducted at field, pasture, and heathland sites forming a strong land use gradient in Northwest Germany. The abundance of 49 species was recorded in 85 plots together with their traits (canopy height, specific leaf area, leaf N, leaf N:P, leaf and stem dry matter content, life cycle, reproductive investment (RI) in seed mass and seed number), as well as parameters describing soil resources and land use disturbances. RLQ multivariate analysis of the data set related an environmental table to a species trait table using a species abundance table to extract the joint structure between them. Thereafter, we clustered the species scores on the RLQ axis to extract functional groups. Traits associated with the leaf economics spectrum were strongly related to soil resources that co-varied with disturbance intensity. A division of the whole land use gradient into agricultural and heathland sites showed that RI was not decoupled from trait-environment relationships. However, different responses of RI to the environment in agricultural sites and heathlands emphasize the relevance of local scales in trait-environment studies.



## Effects of management intensity and habitat complexity on the prey of web-building spiders

Viktoria Mader<sup>1</sup>, Klaus Birkhofer<sup>1</sup>, Volkmar Wolters<sup>1</sup>, Eva Diehl<sup>1</sup>

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Management intensity and habitat complexity affect the structure of arthropod communities and alter predator-prey interactions in terrestrial food webs. We selected twelve sites along a gradient of management intensity to analyze effects of habitat complexity and intensity on prey utilization in web-building spiders. Management intensity was characterized by the sum of applied management practices, i.e. fertilizer and pesticide application, grazing, cutting and harvesting, tillage and crop rotation. Habitat complexity was characterized by vegetation height, horizontal vegetation coverage, plant diversity and vertical spatial resistance. At three dates we hand-collected 12172 prey organisms from spider webs and compared them to 21956 potentially available prey items captured by sticky traps. The number of prey taxa in spider webs was highest in less intensively managed sites. The inverse Simpson index of prey diversity in spider webs was negatively correlated to vegetation height and positively correlated to plant diversity. Aphids were significantly more abundant prey in spider webs compared to potentially available aphids. This pattern was most pronounced at sites with high vegetation and intensive management. In contrast, Collembola, Brachycera and Thysanoptera prey were under-represented in spider webs. Our results emphasize that vegetation characteristics and management practices may lead to a disproportional contribution of certain prey taxa to spider diets.



## Effects of crops and soils on the diversity of the arable vegetation in Kosovo

*Arben Mehmeti*<sup>1</sup>, Demaj Adem<sup>1</sup>, Zogaj Muhamet<sup>1</sup>, Demelezi Imri<sup>1</sup>, Rainer Waldhardt<sup>2</sup>

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Today's arable vegetation of Kosovo mainly differs between crop classes (summer crops vs. winter crops), but hardly changes along gradients of site conditions such as soil base richness or soil moisture. This results of a recent region-wide study (1) may be due to the fact that the larger part of Kosovo's arable land is located in two plains characterised by productive (base rich and moist in spring) soils. We thus tested, if our results can be confirmed based on a sampling design with equally sized classes of arable fields (n=10) considering crop rotation (maize/winter wheat vs. pepper monoculture) and soil types (fluvisols vs. cambisols). Moreover, we tested, in how far results depend on the size of the sampled plots (25, 50, 100 m<sup>2</sup>). Results of the ongoing study will be presented and discussed in the context of the need to promote biodiversity-friendly arable production on the Balkan Peninsula, Europe's major hotspot of biodiversity.



## Diversifying crop rotations with perennial forage crops: Potential benefits for weed management & farmland biodiversity

Helmut Meiss<sup>1</sup>, Nicolas Munier-Jolain<sup>2</sup>, Jacques Caneill<sup>2</sup>, Safia Médiène<sup>3</sup>, Vincent Bretagnolle<sup>1</sup>, Rainer Waldhardt<sup>4</sup>

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<sup>3</sup> AgroParisTech

<sup>4</sup> Justus-Liebig-University Giessen, Institute of Landscape Ecology and Resources Management

Crop rotation may be used to prevent the continuous selection of weed species adapted to one crop type. However, today's crop rotations are often very short and simple. We studied the impacts of introducing perennial forage crops into cereal-based crop rotations on weed vegetation.

Large-scale weed surveys in 632 fields in western France suggested that the weed species composition varied most strongly between perennial alfalfa forage crops and six annual crops [1]. Comparisons of wheat fields before, during, and after perennial alfalfa suggested that weed communities vary in a cyclic way during such crop rotations. This may be beneficial for weed management (suppression of weed species problematic in annual crops) and for plant diversity [2].

Field experiments in Dijon, eastern France, largely confirmed the negative impacts of perennial crops on the population dynamics of major noxious weed species. Moreover, contrasting crop management options permitted investigating the underlying mechanisms. The absence of soil tillage in perennial crops reduced weed emergence, but increased the survival of established weed plants. Additionally, the temporally extended vegetation cover and the frequent hay cuttings reduced the vegetative weed growth and seed production. Weed seed survival was also reduced due to animals (seed predation) [3].

[1] Meiss *et al.* 2010a *Agron. Sustain. Dev.* DOI: 10.1051/agro/2009043.

[2] Meiss *et al.* 2010b *Weed Res.* **50**, 331-340.

[3] Meiss *et al.* 2010c *Agric. Ecosyst. Environ.* **138**, 10-16.



**Urban bryophyte vegetation – Biodiversity on a smaller scale**

*Sandra Richter*<sup>1</sup>, Ingolf Kühn<sup>2</sup>, Stefan Klotz<sup>2</sup>, Helge Bruehlheide<sup>1</sup>

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The objective of this study was to establish and validate habitat models for the urban bryophyte flora of Halle. Focusing on the main three different ecological groups of urban bryophytes (terrestrial, epiphytic and epilithic bryophytes), we aimed at identifying the best predictors for occurrence and cover. Using a randomized sampling design, data were collected in 60 investigated grid cells plots with two urban grasslands, two rock habitats and two host trees per cell. Mixed linear models were developed for predicting the influences of a wide range of environmental variables that were measured in the subplots, in addition to biotic factors such as phanerogame richness and cover or phorophyte identity. For the grassland subplots, the abiotic environment in terms of soil nutrients turned out to have paramount importance, while the predictors for the epilithic bryophytes were mainly determined by the origin of rocks in terms of anthropogenic or natural rock types. For epiphyte coverage tree species identity played a major role. In summary, significant models were obtained for all three groups. The different drivers identified in the models all point to a strong dependence on anthropogenic influences. However, this also opens opportunities for future urban biodiversity projects in modifying the human impact in a way to maximize species richness and coverage.



**Fertilization superimposes the legume effect on microbial efficiency in a grassland plant diversity gradient**

Tanja Strecker<sup>1</sup>, Romain Barnard<sup>2</sup>, Michael Scherer-Lorenzen<sup>2</sup>, Stefan Scheu<sup>1</sup>, Alexandra Weigelt<sup>3</sup>, Nico Eisenhauer<sup>1</sup>

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<sup>3</sup> University of Leipzig

The extreme loss of biodiversity and elevated N deposition are two of the most crucial anthropogenic factors driving ecosystem change. Although both received considerable attention in previous studies, information on their interactions and consequences of these interactions for ecosystems is scarce. In particular, little is known about how soil biota and their functions are affected by combined changes in biodiversity and N deposition. We investigated both the consequences of plant diversity loss and elevated N deposition for the performance and functioning of soil microbial communities on a local scale in the framework of a long-term study in semi-natural grassland (Jena Experiment). The results suggest that N addition significantly increased microbial C use efficiency, but did not alter microbial biomass. Legumes influenced microbial biomass and C use efficiency in the same way but legume impacts were superimposed by fertilization. In contrast, plant species richness enhanced microbial respiration and biomass but did not affect microbial C use efficiency. Our results highlight the role of plant diversity loss and N deposition as well as interactions between plant community composition and N deposition for microbial performance and functioning. Considering the multiple side effects of fertilization, promoting plant diversity and legume presence might be crucial factors improving the functioning of managed grasslands.



**Seed banks of arable fields in Kosovo - Impacts of land use and soils**

*Friederike Luebben*<sup>1</sup>, Rainer Waldhardt<sup>1</sup>, Mehmeti Arben<sup>2</sup>, Demaj Adem<sup>1,2</sup>

<sup>1</sup> Landscape Ecology and Landscape Planning, Justus-Liebig-University Giessen

<sup>2</sup> Universtiy of Pristina

Due to intensive chemical and mechanical weed control the arable weed vegetation all over Europe has dramatically changed. Many species have become rare or extinct. According to Griffiths [1] Kosovo is Europe's major hotspot of biodiversity. Nevertheless, Mehmeti et al. [2] recently showed that today's segetal vegetation in Kosovo is depleted by the dominating maize-wheat-crop-rotation. Whether the biodiversity of plant species really decreased or whether there is still a big potential in soil seed banks to create a sustainable agriculture with high biodiversity is the main purpose of the study presented here. In March 2010, typical soils were sampled in Kosovo. The samples were transferred to Germany and a seed germination experiment under field conditions has been conducted. In addition, ongoing soil analysis (pH, C, N, P, K) and GPS coordinates will provide environmental data on the sampled sites. Preliminary results conform to Mehmeti's research. We will present the results of the seed bank analysis and the impact of land use and soils on the seed bank composition. Moreover, we will discuss the potential of the seed banks to increase the biodiversity of the arable land in Kosovo.

[1] **Griffiths, H.I., Krystufek, B., Reed, M. (Eds.), 2004.** Balkan Biodiversity. Patterns and processes in the European Hotspot. Kluwer, Dordrecht, Boston, London.

[2] **Mehmeti A., Demaj A., Waldhardt R., 2009.** Plant species richness and composition in the arable land of Kosovo. Landscape Online 11/2009. DOI:10.3097/LO.200911.



## The end of an early plant succession phase is accompanied by declining seed rain

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<sup>1</sup> Department for Ecology and Ecosystem Management, Technische Universität München

The potential of a plant species to colonize a new habitat essentially depends on the amount of its seed rain. We studied the initial phase of plant succession including seed rain in the artificial water catchment “Chicken Creek” in a post lignite mining district in Brandenburg, Germany. We registered an increase of different plant species and vegetation cover degree in the catchment and of plant taxa captured in the seed rain traps between 2006 and 2009. However, in the same time period the seed rain decreased in quantity. In August and September 2006 we recorded about 11.9 seeds per square meter and day, which almost exclusively belonged to *Conyza canadensis*. The anemochorous Asteraceae was dominant within the 6 ha catchment in 2006 and 2007 and decreased afterwards in cover degree, individual number and seed rain amount. This resulted in a decrease of the entire seed rain: In August and September 2009 we recorded 3.7 seeds per square meter and day, although the seed abundance generally increased on species level. These developments of increased plant cover degree and simultaneously decreased seed rain amount imply that the potential of anemochorous pioneers was more relevant in the early successional phase than in the following one.



**Biological fixation of atmospheric nitrogen by *Robinia pseudoacacia* L. in short-rotation plantations on post-mining sites in Lower Lusatia (Brandenburg, NE Germany)**

Maik Veste<sup>1</sup>, Christian Böhm<sup>2</sup>, Ansgar Quinkenstein<sup>2</sup>, Dirk Freese<sup>2</sup>

<sup>1</sup> Bioenergy and Agroforestry Research, Hamburg

<sup>2</sup> Chair of Soil Protection and Recultivation, BTU Cottbus

As an early successional and nitrogen-fixing tree species black locust (*Robinia pseudoacacia*) grows rapidly even under unfavourable site conditions. Moreover, it is comparatively drought-tolerant and nevertheless produces a dense and high quality wood. Annual production of oven-dried biomass is up to 6 t ha<sup>-1</sup>. For these reasons, it is highly likely that the importance of black locust for biomass production for bioenergy production with short rotation plantations and agroforestry systems will increase in Brandenburg within the next decades. In this paper we present measurements of biological N fixation (BNF) in leaves obtained by the natural <sup>15</sup>N abundance method and use the results to estimate the annual nitrogen input by black locust. The study was carried out on recultivation sites in the opencast lignite mining area of Welzow-South. As non-nitrogen fixing reference tree *Quercus rubra* was used. The averaged nitrogen content in the leaves of black locust ranged from 3.1% (C/N 14.8) in 15 years old trees to 3.4% (C/N 14.4) in 2 year-old trees, respectively. A higher content of nitrogen was found in leaves of re-sprouted trees with 4.3% (C/N 11.5). The estimated percentage of nitrogen derived from the atmosphere (% NdfA) in black locust was 63% – 83% compared to 56% in *Hippophaë* and 79% in *Genista*. Their nitrogen-fixation ability plays an important role for the improvement of soil fertility of marginal lands and of recultivated ecosystems and landscapes.



**Effects of Nitrogen addition – load and form- and management on acidic grassland vegetation after three years**

*Gaudnik C.*<sup>1</sup>, *Corcket E.*<sup>1</sup>, *Bobbink R.*<sup>2</sup> and *Alard D.*<sup>1</sup>

<sup>1</sup> UMR 1202 INRA BioGeCo Université Bordeaux 1, Talence, France

<sup>2</sup> B-ware Research Centre, Radboud University, Nijmegen, The Netherlands

Atmospheric nitrogen (N) deposition represents a component of global change driving to vegetation changes. Our study aimed to determinate the effects of N deposition on biomass and species richness and to examine a possible mitigation with management.

An increasing addition of total N (0, 35 or 70 kg N ha<sup>-1</sup> yr<sup>-1</sup>) and a cutting frequency, one or two cutting(s) per year, were manipulated in a factorial design on an acidic grassland in France. The form of the N species, oxidized versus reduced, was also distinguished in the highest dose of N.

After 3 years, an effect of cutting showed a decrease of biomass with two cuttings per year confirmed by light measurements. Total N-addition showed no effect on biomass but a marginally effect on species number, suggesting a decline in species richness with N increase. Mitigation effects via more frequent cuttings were unresolved with only a tendency to gain specie with two cuttings at the highest dose of N. On the contrary, grasses biomass increased with addition of oxidized N while no effect of N form was detected on species richness. These results were consistent with an ammonium toxicity hypothesis whereas no evidence of competitive light exclusion was detected.



**Stumps as hot-spots of biodiversity**

*Astrid Taylor*<sup>1</sup>, Anna Malmström<sup>1</sup>, Tryggve Persson<sup>1</sup>

<sup>1</sup> Department of Ecology, Swedish University of Agricultural Sciences

Due to the increasing need to replace fossil fuels with renewable energy alternatives forest products like coarse dead wood (CDW) are investigated as potential sources for bioenergy production. However, many forest-dwelling invertebrates are dependent on CDW like slash and stumps and large scale stump removal may significantly reduce the diversity of these organisms. The present study was part of an investigation funded by the Swedish Energy Agency into the environmentally sustainable production of bioenergy through the removal and burning of tree stumps. The study examined the potential impact of stump removal on several soil invertebrate groups. In southern and central Sweden, oribatid mite and collembolan communities on Norway spruce and Scots pine stumps were investigated, at three forest stands that differed in time since felling (5, 10, 20 years). Stump communities were compared to the surrounding soil in regard to total and relative abundance, species richness and community composition. In particular for oribatid mites, species richness in older stumps (>5 years) was significantly higher than in the surrounding soil. Differences in community composition between both habitats were largest when stumps were 10 years old mainly due to a great proportion of species restricted to the stump habitat. It can be concluded that 'middle-aged' stumps in particular harbor microarthropod communities more diverse than and distinctly different from that found in the forest floor.



## **SESSION 17 - INDICATORS OF SPECIES DIVERSITY FOR ECOLOGICAL MONITORING AND ASSESSMENT**

**CONVENOR: ALESSANDRO CHIARUCCI**

ORAL PRESENTATIONS:

### **Apomictic species groups as indicators of man-made habitats: The genus *Taraxacum* in the Ruhr region**

*Götz Heinrich Loos*<sup>1</sup>

<sup>1</sup> Geographical Institute, Ruhr-Universität Bochum

Phytotaxonomic diversity in man-made habitats include many species that could be used as indicators of typical anthropogenic biotopes. In genus *Taraxacum*, which consists of many apomictic segregates with exclusively apomictic species in large regions, nearly all species inhabit man-made habitats in central Europe. A line could be drawn from the section *Palustria* which include characteristic species of natural to semi-natural, at least hemerobic biotopes (wet meadows, saline habitats) to the species groups that show clear preferences for ruderal biotopes. Within these groups, the new established section *Melanostigma* is constituted of species that are particularly present in hemerobic biotopes of urban-industrial landscapes. The distribution and habitat adoption of the species of section *Melanostigma* were studied in the postindustrial urban landscape of the Ruhr region (Ruhrgebiet, Northrhine-Westphalia, Germany) in relation to their (scarce) occurrences in adjacent less hemerobic rural areas. The possibility of their urban-industrial biotope indicator value is examined.



## Monitoring global biodiversity: The Sampled Red List Index (SRLI)

*Monika Böhm*<sup>1</sup>, Nadia Dewhurst<sup>1</sup>, Jonathan Baillie<sup>2</sup>, Ben Collen<sup>1</sup>

<sup>1</sup> Indicators & Assessments Unit, Institute of Zoology, Zoological Society of London

<sup>2</sup> Zoological Society of London

Biodiversity is being lost at an ever-increasing rate as a consequence of human population pressure. The importance of functional ecosystems to human wellbeing and the significance of biodiversity loss have been recognised by 191 nations which are parties to the Convention on Biological Diversity (CBD) and have pledged to reduce biodiversity loss by 2010. The Sampled Red List Index (SRLI) has been developed as one of the indicators informing global biodiversity targets. It is based on conservation assessments carried out using the IUCN Red List of Threatened Species. In the past, the IUCN Red List has mainly concentrated on conservation assessments of charismatic megafauna (particularly mammals and birds), thus not only creating a taxonomic bias, but also one towards terrestrial ecosystems. At the same time, conservation assessments have been lacking for the vast majority of invertebrates, plants and fungi. Yet these are the main players in ecosystem functioning. This project has helped to broaden the species coverage of the Red List by developing a biodiversity indicator which is broadly representative of global biodiversity and includes previously under-represented taxa (particularly invertebrates) and ecosystems.

The results of the SRLI allow us to identify key regions and taxa that require greater conservation attention. This talk will give a brief overview of the project and show how some of the latest results can be used to inform conservation prioritisation at a global scale.



**Spatiotemporal distribution patterns of epigeic, endogeic and anecic earthworms on a catchment scale in agro-ecosystems**

*Juliane Palm*<sup>1</sup>, Julian Klaus<sup>2</sup>, Loes van Schaik<sup>1</sup>, Erwin Zehe<sup>2</sup>, Boris Schröder<sup>1</sup>

<sup>1</sup> Institute of Earth and Environmental Sciences, University of Potsdam, Germany

<sup>2</sup> Institute of Water and Environment, University of Munich, Germany

Earthworms are key organisms in soil systems and as “ecosystem engineers” affect essential processes such as litter decomposition, water and nutrient dynamics and soil structure formation. Based on their different burrowing and feeding behaviour earthworms are classified in three ecological life forms, representing different habitat requirements as well as different habitat functions. The strong relationship between environmental conditions and earthworm distribution offers the opportunity to use earthworm classes as indicators for different states of soil condition or even as predictors for earthworm induced soil processes on larger scales. In agro-ecosystems that might be useful to evaluate soil health and different soil management strategies. The aim of our study is to develop habitat models for describing the spatial and temporal distribution patterns of the three earthworm classes on a catchment scale in agro-ecosystems. Therefore we carried out field studies on arable fields differing in soil management practices, soil properties and topography in order to identify predictors for earthworm occurrence, abundance and biomass. The patchy distribution and high variability in earthworm data reflect the need for consideration of small-scale variability. Furthermore annual dynamics show the importance of soil moisture, precipitation and temperature for earthworm activity patterns and clarify our final goal to couple distribution models with population dynamics.



## **Vegetation dynamics and rangeland use in northwestern Namibia - Indicators for rangeland assessment**

*Jenny Eisold*<sup>1</sup>, *Anja Linstädter*<sup>2</sup>

<sup>1</sup> Institute for Social-Ecological Research (ISOE)

<sup>2</sup> University of Cologne

Degradation of natural resources has become a serious challenge in drylands, bearing negative impacts on ecosystem service provisioning and livelihoods. In Namibia, the driest country of sub-saharian Africa 45 per cent of the national land area can only be used as rangeland. Many Namibians livelihoods mainly depend on natural dryland vegetation and water resources. This socio-economic importance makes sustainable land use essential, especially because Namibia will be heavily affected by climate change. We evaluate the impact of the local grazing practices on the vegetation and how to indicate ecological thresholds. Direct measures for system shifts are difficult to obtain, due to multiple factor controls that operate at diverse spatial and temporal scales. Consequently there is a need for the development of indicators to determine if an ecosystem is approaching a threshold. We aimed to identify potential early-warning and long-term indicators for crossing a degradation threshold. Long-term indicators were identified as the structural shift from grassland to woodland indicating a major shift in ecosystem service supply, that indicate major ecological restructuring on a functional level symptomatic of land degradation. Furthermore early warning indicators, the ratio between annual and perennial grasses were characterised. In a synthesis this analysis conceptualizes the effects of environmental variability, the supply of ecosystem services and connects this to management rules.



**Indicators of species diversity in a network of protected areas as a tool for assessing ecological diversity and monitoring biodiversity**

*Alessandro Chiarucci*<sup>1</sup>

<sup>1</sup> Department of Environmental Sciences, University of Siena

Inventorying species diversity across a large area or a set of nature reserves is a hard task to be achieved. Sample based information can only be used for this, but there are some problems in upscaling species diversity data because of the lack of reliable estimators. The need for assessing and monitoring species diversity across large scales, such as in reserve networks, make urgent the development of large-scale indicators of species diversity. The present paper discusses the conceptual problems connected with the development of large-scale indicators of species diversity and presents some applications based on real data. The results are discussed in the light of the indicator importance of different groups of species.



POSTER PRESENTATION:

**A brute force approach to vegetation classification**

*Sebastian Schmidlein*<sup>1</sup>, *Lubomir Tichý*<sup>2</sup>, *Hannes Feilhauer*<sup>1</sup>, *Ulrike Faude*<sup>1</sup>

<sup>1</sup> Institut für Geographie, Abt. Vegetationsgeographie, Universität Bonn

<sup>2</sup> Masaryk University, Dep. of Botany and Zoology

We introduce an approach to vegetation classification that is based on a search for high quantity and quality of indicator species for groups (diagnostic species). The algorithm is called Isopam (isometric feature mapping and partitioning around medoids) and can be accessed in R or (with basic options) in Juice. It can be used as a hierarchical, divisive method, or as non-hierarchical partitioning. The underlying brute-force process searches for an optimized partition of an Isomap ordination space. If required, a suited number of clusters is proposed as well. Isopam was tested on 20 real-world data sets and the results were compared with results from other, widely used clustering approaches. The method was particularly powerful for delimiting groups well characterized by diagnostic species.



## SESSION 18 - REMOTE SENSING FOR BIODIVERSITY RESEARCH

CONVENOR: SEBASTIAN SCHMIDTLEIN, MARTIN WEGMANN

### ORAL PRESENTATIONS:

#### **Advances in forecasting species beta-diversity by remote sensing: Current status and future directions**

*Duccio Rocchini*<sup>1</sup>, Harini Nagendra<sup>2</sup>, Brian S. Cade<sup>3</sup>, Kate He<sup>4</sup>, Jens Oldeland<sup>5</sup>, Rucha Ghate<sup>2</sup>, Dirk Wesuls<sup>6</sup>, Markus Neteler<sup>7</sup>

<sup>1</sup> IASMA Research and Innovation Centre, Edmund Mach Foundation, Environment and Natural Resources Area, TN, Italy

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<sup>3</sup> U.S. Geological Survey, Fort Collins Science Center, Fort Collins, USA

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<sup>7</sup> GIS and Remote Sensing Unit, Edmund Mach Foundation

A straightforward method for summarizing beta-diversity is to measure the differences between pairs of plots in terms of their species composition. Then the compositional differences can be correlated with geographical distance among pairs of plots (or species communities) through spatial autocorrelation by further inferring the patterns of species compositional gradients (species turnover). However, spatial distances do not necessarily account for environmental heterogeneity, especially in heavily fragmented landscapes. Substituting spatial distances with spectral distances among sampling units (derived from remotely sensed reflectance values) could be more reliable as this method explicitly takes habitat differences into account. This has been demonstrated at a number of spatial scales and in several habitat types, ranging from local scaled studies in Mediterranean forests, Amazonian tropical forests, Western Ghats (India) tropical forests, tropical dry forests, North and South Carolina (US) lowlands and floodplains, African savannas, to worldwide assessments.

This study aims at: i) summarizing the work done on beta-diversity study by remote sensing considering different spatial scales and habitat types, ii) proposing new analysis approaches based on different modelling techniques, including e.g. LOESS regression, quantile regression, spectral rarefaction, iii) proposing a theoretical framework for developing robust empirical tests on species diversity forecasting by remote sensing.



**Imaging spectroscopy for vegetation analysis - A case study in Brandenburg***Annett Frick<sup>1</sup>*<sup>1</sup> Luftbild Umwelt Planung

The presented study addresses the classification of selected plant associations by means of the combination of QuickBird data with hyperspectral data. The test-site is situated in the north-eastern part of Germany. The former military training site consists of a rich mosaic of different habitats. Image analysis is complemented by vegetation mapping of 80 sample sites as well as field-spectrometry. Since inner-class variability can be much higher than inter-class variability the study concentrates on indices and derivatives. Data mining methods are used to detect robust features to build a knowledge base for classification. The developed method introduces an iterative classification approach where in a first run only spectral library information is involved. Different classifiers are applied. In a next step all pixels of agreement are identified: where all classifiers indicate the same class a new training pixel is located. In a second run those now image related endmembers can be used as well as neighbourhood and object information. After several iterations the increase in overall accuracy stops. The final result is obtained by a weighted majority vote. Within the process contrast maps are produced from the spectral library which are used as the weighing factor. First results indicate that the integration of contrast maps and the iterative classification lead to a substantial increase in accuracy. However to obtain good results a comprehensive spectral library is necessary.



## Detailed Natura 2000 habitat mapping and reliable quality assessment with very high resolution hyperspectral imagery

*Toon Spanhove*<sup>1</sup>, Jeroen Vanden Borre<sup>1</sup>, Guy Thoonen<sup>2</sup>, Birgen Haest<sup>3</sup>, Jianglin Ma<sup>4</sup>,  
Stephanie Delalieux<sup>3</sup>, Jonathan C-W Chan<sup>4</sup>, Desiré Paelinckx<sup>1</sup>

<sup>1</sup> Monitoring Biodiversity Policy, Research Institute for Nature and Forest (INBO)

<sup>2</sup> Vision Lab, University of Antwerp

<sup>3</sup> Hyperspectral research unit, VITO

<sup>4</sup> Department of Geography, Vrije Universiteit Brussel

Accurate vegetation maps are amongst the most useful tools in conservation biology, and have been proven to be valuable to assess the conservation status of protected areas. Traditionally, field mapping and aerial photo interpretation have been used to delineate vegetation patches, but such methods are labour intensive and time consuming. Remote sensing is frequently proposed as a reliable alternative, but insufficient spatial and spectral resolutions have hitherto prevented highly detailed land cover classifications. We exploited the potential of novel remote sensing techniques and airborne, very high resolution hyperspectral imagery for Natura 2000 habitat mapping and quality assessment of heathland ecosystems. Our mapping method consists of an initial, supervised land cover classification, followed by a kernel-based reclassification to delineate Natura 2000 habitat patches. The reclassification results in a map comparable to traditionally produced maps, making them easily understandable for end-users. The quality of these patches is subsequently estimated based on the land cover pixel composition, and was evaluated using 347 independent field assessments. Despite some discrepancies between field measurements and remote sensing estimates, 76% of the assessments of individual quality indicators were correct. These results highlight the potential of remote sensing for detailed habitat mapping and accurate quality assessments, making more frequent evaluations more realistic.



**From mapping to modeling: Integrating multi-temporal remote sensing data into species distribution models at different spatial scales**

*Anna Cord*<sup>1</sup>, Doris Klein<sup>1</sup>, Stefan Dech<sup>2</sup>

<sup>1</sup> Department of Remote Sensing, University of Wuerzburg

<sup>2</sup> German Remote Sensing Data Center, German Aerospace Center, Oberpfaffenhofen

In times of global change and rapid biodiversity loss, making spatially explicit assessments of species' distributions is a core challenge in conservation planning. Thus, field surveys are essential to either collect target species or to conduct biological inventories in a given area. For sustainable management, large areas need to be covered - too costly in terms of time, effort and money to be done with field work alone. In the last two decades, correlative Species Distribution Models (SDMs) - that statistically link species records or abundances to environmental data - and remote sensing (RS) have become standard tools to interpolate between scattered field data using environmental information. Several SDM studies used land cover data, one of the standard RS products, to act as proxy for habitat availability. However, the combination of both techniques is still under-utilized – due to their different scientific background and remaining skepticism on both sides. This study summarizes several examples where multi-temporal RS imagery (representing differences in the vegetation seasonality) was directly integrated into SDMs (Maxent). As mentioned above, scale is a key factor in biodiversity assessments. When predicting species' presence with remote sensing data as a mixed signal of the (plant) species itself and its environment we observe a continuous transition from “mapping” to “modeling”. What do we detect at which cell size? – This is the core question to be discussed.



**Spinning a laser web: Predicting spider distributions using lidar**

Jörg Müller<sup>1</sup>, Kerri Vierling<sup>2</sup>, Roland Brandl<sup>3</sup>

<sup>1</sup> Research department, Nationalpark Bavarian Forest

<sup>2</sup> University of Idaho

<sup>3</sup> Philipps-University of Marburg

The application of Lidar remote sensing to examine relationships between vertebrate diversity and environmental characteristics has been limited. Our objectives were to determine whether lidar could be used to accurately describe single-species distributions and community characteristics of spiders in remote mountainous terrain. We used the  $R^2$  and partial  $R^2$  provided by variance partitioning to evaluate the predictive power of lidar-derived variables compared to ground measurements for each of the community characteristics. The total adjusted  $R^2$  for species richness, the Shannon index, community species composition, and body size ranged from 25 – 57%. Lidar variables and ground measurements both contributed >80 % to the total predictive power. For species composition, the explained variance was approximately 32 %. The predictive power of lidar-derived variables was comparable or superior to that of the ground based variables for examinations of single-species distributions, and explained up to 55% of the variance. The predictability of species distributions was higher for species that had strong associations with shade in open forest habitats, and this niche position has been well documented across the European continent for spider species. The similar statistical performance between lidar and ground based measures at our field sites indicated that lidar is a viable tool to assist species-specific conservation as well as broader biodiversity planning efforts.



## Satellite-based assessment of the effectiveness of protected areas in Eastern Europe during transition

*Pedro J. Leitão*<sup>1</sup>, Jan Knorn<sup>1</sup>, Anika Sieber<sup>1</sup>, Leonid Baskin<sup>2</sup>, Tobias Kuemmerle<sup>3</sup>, Volker C. Radeloff<sup>3</sup>, Patrick Hostert<sup>1</sup>

<sup>1</sup> Humboldt Universität zu Berlin

<sup>2</sup> Russian Academy of Sciences

<sup>3</sup> University of Wisconsin-Madison

Protected areas are a cornerstone of biodiversity conservation worldwide, covering about 12% of the Earth's terrestrial surface. The question is how effective these protected areas are in safeguarding natural ecosystems and their biodiversity, particularly in regions undergoing rapid socio-economic change. In Eastern Europe, the collapse of socialism resulted in an eroding infrastructure for nature protection and increased illegal logging and poaching. On the other hand, much farmland was abandoned and rural populations declined. In this study we use satellite-based mapping of logging as an indicator of the protected areas effectiveness during transition. By using Landsat imagery and Support Vector Machines we reconstructed detailed logging histories for seven protected areas in five Eastern European countries. Our results showed lower logging rates within protected areas. Logging also decreased once protected areas were established, but often peaked right before their establishment. The strength of institutions appeared to determine the success of protected areas, as illustrated by the example of a cross-border reserve within Poland and Ukraine. Moreover, forest privatization triggered rapid logging in some countries, resulting in increased forest fragmentation surrounding protected areas. Our study highlights the challenges nature protection faces, while underpinning the effectiveness of protected areas during times of volatile socio-economics and institutions.



## Vanishing jungle – A study on the loss of orangutan habitat on Borneo

Stefan Ziegler<sup>1</sup>, Patrick Weber<sup>2</sup>

<sup>1</sup> Forest Department, WWF Germany

<sup>2</sup> Dep. of Geography, University of Frankfurt

Due to their primarily arboreal way of living, orangutans are notably affected by the increasing destruction and fragmentation of the tropical rainforest. This study quantifies the loss of orangutan habitat on Borneo over the last 80 years. Additionally, the effects of the rapidly expanding palm oil industry and its implications for the orangutan population were studied. The study reveals that throughout the last 20 years, the habitat of the Borneo orangutan (*Pongo pygmaeus*) has been reduced by at least 55%, primarily due to the conversion of rainforest to fallow land and oil palm plantations, as well as by commercial wood extraction and forest fires. The annual habitat loss in Borneo is currently estimated to be between 454,000 hectares and 614,000 hectares. The creation of oil palm plantations accounts for about 11% to 16% of the conversion of orangutan forests. Almost one quarter of the great ape populations on Borneo already prevail in degraded forests. The findings lead to the conclusion that without a change of course, the habitat of the apes will be largely destroyed by 2025.



## **Observations from space - Ecological change detection and carbon mapping in the Eastern Arc**

*Marion Pfeifer*<sup>1</sup>, Andrew Marshall<sup>1</sup>, Robert Marchant<sup>1</sup>, Simon Willcock<sup>2</sup>, Simon Lewis<sup>2</sup>, Andreas Hemp<sup>3</sup>, Mathias Disney<sup>4</sup>

<sup>1</sup> Environment Department, University of York

<sup>2</sup> Department of Geography, University of Leeds

<sup>3</sup> University of Potsdam

<sup>4</sup> Department of Geography, UCL

Land cover and land structure traits determine the landscape's role in ecological and atmospheric processes. Topographic heterogeneity has been linked to species richness. The capacity of land cover types to sequester carbon depends on vegetation structure and is linked to biomass and LAI.

In the Eastern Arc Mountains, a biodiversity hotspot in tropical East Africa, vegetation cover has changed over the past decades. Using Earth Observation monitoring, we will quantify changes in land cover types and vegetation biogeophysical traits. We will assess consequences for local species-richness and regional carbon sequestration as a base for conservation planning. Potential losses in carbon-sequestering vegetation types will be discussed in the context of carbon emission offsets that may offer developing nations incentives for reforestation and act as economic deterrent for deforestation.



**MS.MONINA - A GMES multi-scale service for habitat monitoring of European Community Interest***Stefan Lang*<sup>1</sup><sup>1</sup> Centre for Geoinformatics, Salzburg University

NATURA 2000, an endeavor in the spirit of the Convention of Biological Diversity (Rio, 1992), is one of the success stories among pan-European initiatives and one of the world's most effective legal instruments concerning biodiversity and nature conservation. The EU Habitats Directive (Council Directive 92/43/ECC) requires a standardized monitoring of the habitat types and a reporting every six years. The rapidly developing remote sensing sensor technique and also new image processing methods offer new possibilities to apply Earth observation (EO) data for NATURA 2000 monitoring. Today, with GMES pushing EO-based achievements from both space- and in-situ sensors and the vision of a unified and integrated (i.e. single and shared) European Information Space (SEIS, SISE), set the stage for a technologically mature, integrated, and user-centric system, more effectively to be used than ever. The talk will present the innovative conceptual framework of the EC-FP7 (SPACE) project MS.MONINA. The project follows a pan-European approach that on the one hand reflects the specifics and the variety of habitats in the different biogeographical regions, and on the other hand guides the specifications of the service chains as and their implementations as service cases and pilots. The multi-scale (MS) concept reflects the fact on different (administrative) levels there are specific requirements for sensitive sites-related reporting, monitoring, management etc.



POSTER PRESENTATION:**Application and evaluation of an object-based classification method for the acquisition of linear wooden landscape structures in the Muensterland region**

*Julia Baumeister*<sup>1</sup>, Jan Thiele<sup>1</sup>, Andreas Völker<sup>2</sup>

<sup>1</sup> Institute of Landscape Ecology, University of Muenster

<sup>2</sup> EFTASRemote Sensing Transfer of Technology GmbH, Muenster

We applied an object-based classification procedure to extract linear wooden landscape structures (hedgerows, alleys, & tree rows) from a 50cm-resolution true-color orthophoto. The thematic accuracy was evaluated by comparing the classification results to reference data obtained in the field. The 1.6 km x 2.0 km study area is situated in the north-west of the town Emsdetten in northern North Rhine-Westphalia. The classification was conducted with eCognition Developer 8.0. After segmenting the picture, a nearest neighbor classifier was applied. Using form features and context, the classification was improved in the next step. For accuracy assessment queries in ArcGIS 9.3.1 were used. The results of a qualitative accuracy assessment showed that 140 out of 146 linear wooden structures mapped in the field were recognized by the classification. However, producer's accuracy was 75 %, user's acc. only 15 %. The low results are due to the characteristics of the reference data, representing not the crowns but the footprint of the landscape elements. Buffered sample points imitating crown width showed a big improvement in accuracy: Within a 5 m radius user's acc. increased up to 71 %, producer's acc. rose to 93 %. The remaining errors in classification are due to different uncertainties incl.: artefacts from the segmentation process, refinement on some image objects, misclassification on others and possible shift of high structures (trees) in the picture due to the image acquisition system.



## SESSION 19 - ECOLOGICAL MODELING OF COMPLEX SYSTEMS

CONVENOR: HAUKE REUTER, FRED JOPP

ORAL PRESENTATIONS:

### **Spatio-temporal patterns of gene flow and dispersal under temperature increase**

*Otto Richter*<sup>1</sup>

<sup>1</sup> Institut für Geoökologie, Technische Universität Braunschweig

Temperature is one of the major driving forces of gene flow and dispersal. In this paper the spatial dynamics of genetic dispersal is studied under the auspices of temperature increase by means of a mathematical model. The main elements genetics, competition and dispersal are combined in a coherent approach by a system of coupled partial differential equations with nonlinear reaction terms describing population dynamics, genetic exchange and competition. Temperature reaction norms are conferred by a two allele system. The nonlinearities of the interaction terms give rise to a richness of spatio-temporal dynamic patterns. Here we show that invasion processes are initiated by a temperature induced bifurcation in phase space. This leads subsequently to dispersal in form of travelling waves, if a density threshold is surpassed.



**A modelling approach to estimate regional dispersal processes: Case study on maize gene flow in Northern Germany**

*Broder Breckling*<sup>1</sup>, Hauke Reuter<sup>2</sup>

<sup>1</sup> Chair for Landscape Ecology, University of Vechta

<sup>2</sup> ZMT Bremen

Dispersal is a fundamental process shaping developments in ecological systems. Usually dispersal can be studied in experimental settings on the local scale. On the regional scale - encompassing large areas - the ongoing dispersal processes usually cannot be directly measured. Modelling is required for extrapolations which originate from a local dispersal regime and are analysed across larger regions. Regional dispersal modelling builds on measurements of the factors which influence local dispersal and employs statistical considerations on how these factors vary in a biogeographic context to provide large-scale extrapolations.

We exemplify the approach for a regional cross-pollination study in maize (*Zea mays*). Local cross-pollination studies are available to specify a dispersal kernel. Together with geostatistically valid regional field size and field location pattern, large-scale estimations on cross-pollination are obtained. The modelling results are important in the biosafety context of genetically modified varieties. Estimating potential gene flow basing on cross-pollination can help to estimate, in which regions the coexistence regulations would successfully facilitate legally required purity standards to segregate genetically modified and conventional traits. It can also help to identify regions where the agricultural structure would eventually lead to an undesirable extent of gene flow which would limit the choice of farmers of traits to cultivate.



## Changes in bird distribution due to global warming – A first high resolution modelling approach for Germany

*Thomas Gottschalk*<sup>1</sup>

<sup>1</sup> Department of Animal Ecology, Justus-Liebig-University Giessen

Modelling of bird distribution change due to climate warming has been carried out at a relatively coarse resolution, often using a 50 km grid and ignoring small regional differences in habitat use and topography. The aim of our study was to predict species distribution change in Germany at a fine resolution, in order to overcome low model fit and to improve prediction accuracy. Resource selection functions based on a GLM and on data from the German Common Breeding Bird Survey (300,000 breeding bird records) were used to predict the current occurrence probability and population size of selected bird species. We used the resource selection functions for prediction of changes in population size, applying these to regional simulations of the IPCC scenarios for the year 2050. Here, for the first time, we estimate range shifts of European birds related to climate change on a high spatial resolution at the national scale. Although land-use was the main factor affecting species distribution climate variables significantly influenced distribution patterns. Models projected strong spatially varying impacts on the bird species used in the study. The greatest changes in species distribution due to climate change were predicted for Eurasian Nuthatch, Dunnock, Goldcrest, whereby the lowest were for Great Spotted Woodpecker, Blackcap and Crested Tit. Despite these climate-driven changes, our results suggest that the effects of climate effects are most likely to be subordinate to future changes in land use.



**Biome shift, tree cover change and climate driven uncertainty for 2050, West Africa**

*Jonathan Heubes*<sup>1</sup>, Ingolf Kühn<sup>2</sup>, Konstantin König<sup>1</sup>, Rüdiger Wittig<sup>1</sup>, Georg Zizka<sup>1</sup>, Karen Hahn-Hadjali<sup>1</sup>

<sup>1</sup> Biodiversity and Climate Research Centre

<sup>2</sup> UFZ-Halle Leipzig

Africa is expected to face severe changes in climatic conditions affecting biomes and tree cover. Thus, our objectives are to model: 1) direction and extend of future biome shift (2050) and 2) tree cover, while accounting for human impact; and 3) identify trends despite high uncertainty in future climate projections. We modeled future spatial distribution of major biomes in West Africa by using six bioclimatic models while tree cover change was analyzed with Generalized Additive Models. We used climate data from 17 General Circulation Models (GCMs). Consensus projections were derived via weighted average to: 1) reduce inter-model variability and 2) describe a trend from the different GCM projections. Climate change strongest affects grassland resulting in a northern expansion of its bioclimatic envelope in the magnitude of 2 million km<sup>2</sup> (uncertainty: ± 550 000 km<sup>2</sup>). Savanna is projected to lose area in the south (54 x 104 km<sup>2</sup>) while deciduous and evergreen forest are supposed to expand (64 and 77 x 104 km<sup>2</sup>). Tree cover projections indicate an increase in tree cover for central forested parts of West Africa and decreasing tree cover at coastal areas. Furthermore, human impact negatively affects tree cover and even inverts the trend. Despite the GCM-based uncertainty we extracted a trend of future vegetation change. Simulations indicate a climate driven greening trend by 2050. However, human impact may enforce desertification by reducing vegetation cover via internal feedbacks.



## Simulating wildfires in Africa

*Veiko Lehsten*<sup>1</sup>, Almut Arneth<sup>1</sup>

<sup>1</sup>Division of Physical Geography and Ecosystems Analysis (ENES) Department of Earth and Ecosystem Sciences, University of Lund

Wildfires are of high importance for the vegetation and the greenhouse gas exchange in the African continent. Typical fire return intervals for African savannas are between five and two years. Almost all wildfires are ignited by humans who have been using fire as a landscape management tool since millennia. To correctly simulate African vegetation therefore requires accounting for the overall fire effects as well a number of indirect effects of wildfires on vegetation. The latter also requires to correctly simulate the intra-annual distribution since the fire effects depend strongly on the climatic conditions during the fire event. We present a fire model (SPITFIRE) implemented within the dynamic vegetation model LPJ-GUESS and demonstrate the effects that a change in fire frequency has on the vegetation structure of African savannahs. An application of the burned area model using climate projections shows (i) the performance of the model in predicting current burned area amounts, (ii) how the burned area is expected to change as well as (iii) its effects on vegetation.



**A system ecology approach based on the combination of remote sensing and process modeling and its application to mangrove ecosystem in Vietnam**

*Hoang Anh Nguyen*<sup>1</sup>, *Otto Richter*<sup>1</sup>, *Van Quy Pham*<sup>2</sup>

<sup>1</sup> Institute for Geoecology, Technical University of Braunschweig

<sup>2</sup> CanGio Protection Forest Management Board, HoChiMinh City, Vietnam

It is well-known that the mangrove ecosystem plays important roles in coastal regions by its functions including, inter alia, supplying food and fuel wood for humans and natural protection against erosion. Moreover the mangrove ecosystem has become one of the key factors in considering the global change issue and is thus becoming increasingly important. However, the mangrove management is quite a complex undertaking because of its geographic conditions. Satellite remote sensing together with a mathematical model that simulates the underlying processes governing the growth of mangrove in dependence of environmental factors such as salinity or elevation were found to be effective tools for these purposes. In this paper, an ecological model to simulate the development of mangrove attributes is presented; its results are compared to remotely sensed data (ASTER and Landsat images) both in species and leaf area index distributions. CanGio Mangrove Biosphere Reserve of Ho Chi Minh City in Vietnam was selected for the study as an example for applying those combined tools in analyzing mangrove development.



**Incorporating herbivore-plant-interactions into a population dynamics model of the green oak leaf roller (*Tortrix viridana*)**

Silke Knoche<sup>1</sup>, Hilke Schröder<sup>2</sup>, Ronald Bialozyt<sup>2</sup>

<sup>1</sup> Conservation Biology, University of Marburg

<sup>2</sup> Institute for Forest Genetics, vTI, Großhansdorf

In this study we investigated the interactions between *T. viridana*, a forest pest species, and one of its hosts, *Quercus robur*, in Central Europe. Mass outbreaks of *T. viridana* which can cause complete defoliation occur in a periodic sequence every six to eight years. We developed a model which generates such population cycles. It includes a density-dependent regulation with a time-delay of two generations. It is well known that such delays are necessary to generate cycles with a period of more than six generations. This delayed negative feedback could be caused by herbivore induced change of leaf quality of the host tree or by maternal effects, respectively. To investigate which form of regulation (or both) is realised in *T. viridana* populations, we conducted feeding experiments with larvae. We fed one part of the larvae with leaves from sensitive (in mass outbreaks strongly defoliated) oaks and the other part with tolerant (in mass outbreaks weakly defoliated) oaks, assuming different leaf qualities. First results showed a longer developmental time of larvae and a higher mortality of pupae fed with tolerant leaves. In the subsequent year we will investigate the transmission of the effect of leaf quality to the next generation through maternal effect. The results of this experiment will be the basis for parameterisation of our developed model.



**Ecological modelling in aquatic and terrestrial environments – How does the research object influence theory and practice**

*Hauke Reuter*<sup>1</sup>, Fred Jopp<sup>2</sup>

<sup>1</sup> Ecological Modelling, Centre for Tropical Marine Ecology (ZMT)

<sup>2</sup> IGB, Berlin

Modelling has gained increasing importance in analysing and understanding different ecological systems over the last decades. Identifying the complex relationships between ecological patterns and processes is a crucial task. Model development is proved of being of vital importance for making this connection in ecology. However, the way in which central modelling terms and notions are applied obviously differs between terrestrial and aquatic ecosystem approaches. In the aquatic context for a long time we find a concentration on food web models, models of plankton dynamics in relation to nutrient dynamics and steady state models. A comparable concentration of approaches is not apparent for ecological modelling in the terrestrial realm. In both systems we currently find a strong diversification of approaches combined with attempts to couple different model types relating to different organisational levels. The contribution will demonstrate the current developments and explain how different system processes lead to different predominating modelling approaches. These will be demonstrated with different examples from the aquatic and terrestrial context and it will be discussed how the concepts can be applied across system boundaries.



## Body mass and network structure drive food-web robustness against species loss

*Jens Riede*<sup>1</sup>, Ulrich Brose<sup>2</sup>

<sup>1</sup> TU-Darmstadt

<sup>2</sup> Uni Göttingen

Scientists urgently need to better understand how the current catastrophic loss of species directly due to human activities may further accelerate indirect losses of biodiversity in complex natural ecosystems. We explore such interdependence by simulating nonlinear population dynamics after primary species extinctions in nine complex natural food webs. We find that the risk of “secondary” species loss due to “primary” species loss depends on certain characteristics of the species initially lost and the food webs within which they interact.



## The next generation of biodiversity modeling: UIBM – the Universal Individual-Based Model

Uwe Grueters<sup>1</sup>

<sup>1</sup> <http://uibm-de.sourceforge.net>

The majority of the Central-European vascular plant diversity lies in herbaceous grassland communities. The interaction of management intensification, nutrient load and climate change factors is threatening species with extinction in those communities. UIBM aims to simulate biodiversity responses to these threat factors.

UIBM is proposed to enter the next, the process-based generation of biodiversity modeling with the following basic idea behind: Once a template species is successfully constructed from plant trait databases and a Universal Individual-Based Model is built along that way, more species are to be constructed with ease, since the information in the databases is identical for all species.

UIBM, the model developed from this idea, is an individual-/agent-based model with a functional–structural basis.

UIBM's functional basis consists of widely-used energy and gas exchange models at the organ level scaled up to the canopy level via a layered radiation interception and turbulent transfer model.

As part of the structural basis a methodology was developed to construct the template species from trait minima/maxima contained in databases. The methodology, in principle, relies on multivariate allometry, serial biological reasoning and universal scaling laws.

The parametrization experience gained with the chosen template species (False oat-grass, *Arrhenatherum elatius*) will be reported and likely applications of UIBM once more species are constructed will be discussed.



**Stray or stay? Evolution of dispersal polymorphisms can be triggered by a mobility - fertility trade-off**

Emanuel Fronhofer<sup>1</sup>, Alexander Kubisch<sup>1</sup>, Thomas Hovestadt<sup>1</sup>, Hans Joachim Poethke<sup>1</sup>

<sup>1</sup> Field Station Fabrikschleichach, Universität Würzburg

Specialized dispersal morphs are well known from a large number of taxa, and, often, different phenotypes may coexist in one population. More dispersive types have often been found to be less fecund, as shown e.g. for the sand field cricket *Gryllus firmus*. It was thus postulated that there is a trade-off between dispersal ability, i.e. the maintenance of a flight apparatus which reduces dispersal mortality, and fertility. To our knowledge, this hypothesis has never been validated theoretically. Furthermore, it is unclear what specific conditions promote the evolution of such dispersal polymorphisms. Therefore, we use an individual-based simulation approach to analyze the relevance of various key-factors (environmental conditions, life-history attributes, genetic system) for the evolution of dispersal strategies. We will demonstrate that a dispersal mortality – fertility trade-off may lead to a dimorphism in dispersal propensity. A clear dimorphism between dispersive and non-dispersive animals that respectively did and did not reduce their fertility in order to minimize dispersal costs evolved only in diploid systems. The form of the functional relationship between dispersal mortality and the fertility trade-off, as well as the amount of linkage disequilibrium between dispersal-relevant traits, were of decisive importance to the stability of the dimorphism. The dimorphism reported here is an emergent model property, while the underlying trait is quantitative and not assumed to be a threshold trait.



**Bet-hedging strategies in perennial grassland plants: Linking traits to stochastic growth**

*Jakob Gerstenlauer*<sup>1</sup>, Kerstin Wiegand<sup>1</sup>

<sup>1</sup>*Georg-August Universität Göttingen*

All plant species have to cope with uncertainty in environmental resources and conditions. This unpredictability is reflected in the variance of demographic rates, such as seedling survival and fertility. Both mean and variance of these rates may be altered by land-use intensification. Therefore, it becomes increasingly important to predict the response of species to land-use changes. Predictions are ideally based on functional traits linked to life-history attributes. Seed dormancy and perenniality provide preadaptation to harsh and unpredictable environments. However, we do not know the trade-offs among seed dormancy, perenniality and other key traits such as asexual reproduction, seed biomass, and the ability for spatial dispersal. Here, we use stochastic stage-structured matrix population models to investigate the interplay between life-history traits and environmental conditions in terms of the mean and stability of stochastic growth of plant populations. We look at both communities of European grassland plants (i.e. a potential trait space) and specific species. We show that life-history traits strongly interact. This indicates a weakness of the popular Evolutionary Stable Strategy approach which focuses on single traits. We compare the potential bet-hedging effect of traits, i.e. their ability to stabilize the stochastic population growth rate. Our model shows that seed dormancy, sexual reproduction, and small seed size increase population growth for a wide range of environmental conditions.



## Quantifying the deviance of nature from forest model predictions

*Lorenz Fahse*<sup>1</sup>

<sup>1</sup> ETH Zürich

A major challenge for ecologists that use quantitative models is comparing how well model output approximates empirical data. It is sometimes desirable (or unavoidable) to estimate whether or not simulated data match observations in an acceptable way – though it is far from being trivial. As an example, we consider here dbh-class distributions that are simulated by forest succession-models and that can be compared with data from real stands. Classical approaches like multiple t-tests with Bonferroni correction seem sometimes to be inappropriate since they do not account for correlations between the different size classes. But how can differences between two data sets (both simulated and empirical data) correctly be assessed? Ideally, a statistic should be able to assess multiple data sets, account for covariance within the data structure, and produce a metric that allows the researcher to statistically accept or reject whether or not an empirical and simulated data set are the same. Beside some geometrical approaches, the concept of the Mahalanobis-distances that is normally used in conjunction with a linear discriminant analysis is found to be a promising but so far neglected approach that can be used for a broad range of cases for model validation in general. Here I will describe the pro and cons of this method, and reveal that the title of this contribution is more than just ironical.



**Distance correction avoids erroneous scale effects in species-habitat models**

*Birgit Aue*<sup>1</sup>, Klemens Ekschmitt<sup>1</sup>, Stefan Hotes<sup>1</sup>, Volkmar Wolters<sup>1</sup>

<sup>1</sup>Animal Ecology, Justus Liebig University

There is consensus among ecologists that organisms perceive habitat characteristics on specific scales. The spatial scale at which the strongest correlation is observed between habitat cover and species occurrence is generally assumed to indicate the characteristic distance across which the species is influenced by the habitat. Correlation strength over scale was analyzed in simulations assuming different distance kernels of habitat influence, and in two extensive datasets of birds. Regressions were run with four levels of distance correction, down-weighting more distant habitat in the predictor variable. Omitting distance correction proved equivalent to a grossly unrealistic assumption of how habitat influence changes over distance. Introducing adequate distance correction into the regressions consistently transformed humped correlation curves into saturation curves, with high correlations at large scales. The conclusion is that humped correlation curves are artifacts from inadequate distance correction and are prone to misinterpretation. In the presentation two approaches to implementing distance correction in species-habitat regressions are demonstrated.



**Ecological modeling—How-to teach complex dynamics?***Fred Jopp*<sup>1</sup><sup>1</sup> Dept. of Shallow Lakes and Lowland Rivers, IGB Berlin

Conceptual build-ups in ecological modeling have broadened the available approaches to describe large ecological interaction networks. Various techniques are widely accepted as a useful expansion of this scientific discipline. Giving an overview on ecological modeling techniques seems to be a difficult task. Currently there is a tendency to specialise in just one or a few related techniques and limit the research view to the scope of objects that can be captured by it. An alternative teaching strategy for modellers would be just the opposite: explaining the major available techniques with their pros and cons, thereby enabling the educated reader to draw own conclusions, which modeling approaches are best for a given ecological issue—then seek cooperation for application. Such a wide outline can only be gained in a larger cooperation of specialists. In the last two years we convened a group of specialists for this purpose. The resulting synoptic overview of the state-of-the-art in ecological modeling starts with a system-analytical introduction as common basis for modeling. Then a variety of modeling techniques are presented, incl. steady state models, ordinary and partial differential equations, cellular automata, Leslie matrices, L-systems, agent-based models and others. Case studies are introduced that use the so far presented techniques. Finally strategies of model development and validation are given before the outlook to future modeling strategies in ecology is outlined.



POSTER PRESENTATIONS:**Comparing modelling approaches at two levels of biological organisation – Climate change impacts on selected Natura 2000 habitats**

*Torsten Bittner*<sup>1</sup>, Anja Jaeschke<sup>1</sup>, Björn Reineking<sup>2</sup>, Carl Beierkuhnlein<sup>1</sup>

<sup>1</sup> Department of Biogeografie, University of Bayreuth

<sup>2</sup> Biogeographical Modelling, University of Bayreuth

Habitats are characterised by their plant species composition. Therefore, climate change impacts on habitats can be assessed by two complementary statistical approaches: Either directly, modelling the climate envelope of the habitat, or indirectly, by modelling the habitat in terms of its plant species.

Potential climate change impacts on the distribution of European protected Natura 2000 sites were modelled for five natural and semi-natural grassland habitat types, defined by the EU Habitats Directive, using data from the Atlas Florae Europaeae and reports on Natura 2000 sites. We used random forests (RF) and logistic regression (GLM) to model the current and potential future distribution for 2050.

All habitats are projected to lose between 22% and 93% of their range in the no dispersal scenario. In the unrestricted dispersal scenario, almost all habitats gain suitable climate space.

In the direct habitat approach, both model algorithms have high discriminatory performance on test data and are well calibrated. In the indirect species approach, only GLM shows high model performance; RF models are overfitted.

Projections of occurrence probabilities differ more strongly between model approaches (direct vs. indirect) than between model algorithms (GLM vs. RF).

The choice of modelling approach can strongly affect the assessment of potential climate warming impacts. The application of modelling at different levels of ecosystem organisational levels is a promising area of future research.



**Temperature responses in physiologically structured population models for *Gammarus pulex* (L.)**

Anne-Kathrin Schneider<sup>1</sup>, Sylvia Moenickes<sup>2</sup>

<sup>1</sup> University of Potsdam

<sup>2</sup> Technische Universität Braunschweig

Physiologically structured population models link processes on individual level to population structure. We parameterized temperature dependent growth and mortality of the freshwater shrimp *Gammarus pulex*. Thereby we focused on two aims. On the one hand, we compared the accuracy of models that we parameterized with a) laboratory, b) mesocosm and c) field data. On the other hand, we used this parameterization to derive information about possible effects on the population structure and shifts in phenology that are supposed to result from a temperature rise that comes along with global change.



**Bridging the gap between the statistical model and the process-based model: In case of the Crop Growth Modeling in Haean, South Korea***Bumsuk Seo*<sup>1</sup><sup>1</sup> Plant Ecology, Bayreuth University

This paper develops the practical approach of Bayesian statistics incorporated into the computational simulation model in crop production modeling. Among all possibility, the derivation of confidence interval is the most important task. In the first phase, we developed a Bayesian hierarchical model (HBM) to analyze the annual physiological growth of the five major crops. HBM is proposed to incorporate prior knowledge to the experimental results in coherent manner. The HBM computes the biomass production and the gas exchange values at the 32 experimental plots. It has to confront the uncertainty in both inputs and outputs. Secondly, the process-based simulation model PIXGRO plays the same role for the target points. The confidence interval of the model should be derived following a method of Oijen et al. (2005) and Tao et al. (2009). While comparisons made onto the HBM, a set of information criterion can be applied to evaluate the performances of each model. In those efforts, we aim to take an advantage both from process-based model and the statistical model and to support it is a suitable and feasible to integrate environmental models into decision making framework.



**Individual based modelling of coral reef system dynamics***Andreas Kubicek<sup>1</sup>*<sup>1</sup> Ecological Modelling, Leibniz-Zentrum für Marine Tropenökologie (ZMT) GmbH

Tropical coral reefs feature extraordinary biodiversity and high productivity rates in oligotrophic waters. Their occurrence and persistence strongly depends on a multitude of biotic and abiotic environmental conditions. Due to their huge diversity, they exhibit a complex pattern of interactions between organisms and their environment with feedback loops within and between trophic as well as different integration levels. The aim of this work is to improve the understanding of reef resilience and phase shifts by applying an individual based model of a coral reef system, that integrates qualitative and quantitative expertise gained from empirical studies, and includes a spatial representation of organismic competition.

At this stage of development the model is a monthly iterated, spatial simulation of reef system dynamics which emerge from individual interactions between randomly placed coral colonies and macroalgae, and their environment. Both taxa exhibit distinct growth rates, rules for interaction and modes of dispersal (e.g. recruitment, algal fragmentation). Higher trophic levels, like grazers and predators, and important abiotic factors will be added successively. To simulate external impacts on the reef, disturbance events which eliminate all organisms from affected areas occur randomly in space and time. The future intention is to apply the model for the analysis of specific reef sites with distinct environmental settings.



## **SESSION 20 - DEALING WITH COMPLEXITY IN FUNCTIONAL BIODIVERSITY RESEARCH: DATA, EXPERIMENTS AND MODELS**

**CONVENOR: FLORIAN JELTSCH**

ORAL PRESENTATIONS:

### **Approximate Bayesian parameter estimation for a stochastic tropical rain forest model**

*Florian Hartig<sup>1</sup>, Claudia Dislich<sup>1</sup>, Andreas Huth<sup>1</sup>*

<sup>1</sup> Helmholtz Centre for Environmental Research – UFZ

Stochastic simulation models are indispensable tools in ecology and biology. Their use ranges from understanding evolutionary changes of nucleotides to forecasting the global carbon balance of the biosphere. However, a major drawback is the lack of generally accepted methods for parameterization, model selection, and uncertainty assessment of stochastic simulation models. One solution for this problem are likelihood approximation methods that allow applying state-of-the-art statistical tools such as maximum likelihood estimation and Bayesian inference to stochastic simulation models. We discuss the functioning of these methods at the example of a tropical rain forest model (FORMIND).



## **Linking response-and-effect traits to long-term carbon dynamics of forests via community ecology using a vegetation model**

*Frederic Holzwarth*<sup>1</sup>

<sup>1</sup> AG spezielle Botanik und funktionelle Biodiversität, Uni Leipzig

We use the dynamic global vegetation model LPJ-GUESS to study the influence of natural and anthropogenic processes, like management and browsing, on long-term shifts in the species composition and important C-stocks and C-fluxes.

The formulation of the model components allows a strongly data oriented approach. Model parameterization, especially functional traits of tree species, is based mainly on field data provided by the “Biodiversity Exploratory” Project.

For our purpose, a grouping of traits into response-and-effect traits helpful. Response traits determine how a plant reacts to environmental change (e.g. drought resistance, palatability), effect traits are those, which characterize a feedback on the environment (e.g. wood density, growth architecture).

Response-traits explain alteration of community composition due to environmental influence, while changes of ecosystem processes get reflected by changes in the representation of effect-traits.

We make use of the above mentioned model to estimate species abundance and thus representation of effect traits in a changed ecosystem. The relationship between response-and-effect traits, mediated by community ecology, will then be analyzed and environmental changes be scaled up to long-term carbon dynamics.



**Ecosystem services and disservices delivered by ants in cacao agroforests:  
A multi-level Bayesian SEM approach**

*Yann Clough*<sup>1</sup>, Arno Wielgoss<sup>2</sup>, Teja Tschardtke<sup>1</sup>

<sup>1</sup> Agroecology, Dept. of Crop Sciences, University of Göttingen

<sup>2</sup> Agroecology, Dept. of Crop Sciences, University of Göttingen, University of Würzburg

It is generally accepted that functionally important species groups provide ecosystem services to humans. Yet ecosystem disservices are also produced, sometimes by the same organisms, and predicting outcomes in real ecosystems is complex.

Ants are an ubiquitous and functionally important, especially in the tropics. In cacao agroforestry systems they are important predators of arthropod herbivores, but may also spread fungal plant pathogens. It is unclear how important the relative effect of these two mechanisms are for yield outcome. Furthermore, it has not been settled whether ant community characteristics such as species richness or the presence of numerically dominant ants drive those patterns in the field.

To deal with the complex network of hypothesised relationships and the multiple spatial scales involved, we took a multi-level Bayesian structural equation modelling (SEM) approach. We built a model integrating ant community characteristics, abiotic variables, agronomic parameters and their hypothesised relationships based on preliminary data and published studies. This model was then parametrised using an extensive dataset on ant communities and agronomic parameters collected on 420 cacao trees in 42 Indonesian agroforests.

We show how ecosystem services and disservices are generated and discuss the relative roles of ant species richness and abundant invasive ants in driving the herbivore and plant pathogen patterns, and ultimately, yield outcome.



## **Mainland-island or metacommunity dynamics? Models of plant diversity in a fragmented landscape**

*Felix May*<sup>1</sup>, Itamar Giladi<sup>2</sup>, Yaron Ziv<sup>2</sup>, Florian Jeltsch<sup>3</sup>

<sup>1</sup> Leibniz Centre for Agricultural Landscape Research - ZALF

<sup>2</sup> Ben-Gurion-University, Beer Sheva

<sup>3</sup> University Potsdam, Leibniz Centre for Agricultural Landscape Research – ZALF

Habitat loss and fragmentation are major threats for biodiversity in agricultural landscapes. Therefore, understanding and predicting diversity pattern in fragmented landscapes is of high interest for conservation biology. One main issue in this context is the linkage between local communities by dispersal and the resulting community structure and organization at the landscape level.

The theory of island biogeography assumes that species dispersal occurs exclusively between a large continuous habitat (mainland) and smaller habitat patches (islands), while metacommunity theory suggests that dispersal potentially links all local communities (patches) in an archipelago like system.

We extended Hanski's incidence-function model to analyze the implications of these contrasting assumptions. The basic model treats each species independently although species interactions might seriously constrain diversity. Therefore, we included interactions into the model.

We fitted models with different assumptions on dispersal and interactions to data from the Southern Judean Lowlands, Israel. This landscape consists of discrete patches of natural vegetation embedded within an agricultural matrix, and with adjacent continuous natural areas that serve as a mainland.

Based on the fit between model and data, we select the model with the most appropriate process detail and the optimal parameter combinations. This model can be used to evaluate the effects of land use and conservation scenarios on species diversity in our study landscape.



## Effects of plant diversity on plant water niche differentiation

Marc-André Allers<sup>1</sup>, Nina Buchmann<sup>1</sup>, Romain Barnard<sup>1</sup>

<sup>1</sup> Institute of Plant Sciences, ETH Zürich

Plants in mixtures generally have a larger biomass and suffer less water stress than plants growing in monocultures. This may be related to both increased niche differentiation and reduced evaporation through increased ground cover in more diverse communities. We investigated water-related niche differentiation in grassland communities of varying plant species richness in the “Jena Experiment”, using stable isotope ratios of oxygen and deuterium ( $\delta^{18}\text{O}$  and  $\delta^2\text{H}$ , respectively) at several dates.  $\delta^{18}\text{O}$  and  $\delta^2\text{H}$  were measured in soil water at different depths and plant xylem water, the latter providing an integrated signal of the water taken up by the plant species. We found that the source water taken up by plants differed between species but not between plant functional groups (grasses, legumes, tall herbs and small herbs). Comparing diversity responses of soil water and plant xylem water showed that some changes in niche differentiation occurred with diversity at the species level, but not at the functional group level. Our results support the “species identity matters” line of understanding of the effects of plant diversity on ecosystem functioning.



### Using plant functional types to better link models and data of grassland biodiversity

*Hans Pfestorf*<sup>1</sup>, Lina Weiß<sup>1</sup>, Felix May<sup>1</sup>, Florian Jeltsch<sup>1</sup>, Daniel Prati<sup>2</sup>, Markus Fischer<sup>2</sup>

<sup>1</sup> Plant Ecology and Nature Conservation, University of Potsdam

<sup>2</sup> Institute of Plant Sciences, University of Bern

Identifying drivers of species diversity is a major challenge in understanding and predicting the dynamics of grasslands. There have been different ways to approach this challenge. Field studies often investigated the influence of land use regime on plant diversity, but frequently failed to link observed patterns to processes, because contributing factors cannot be disentangled. Modeling approaches have the advantage that simulated patterns can be clearly attributed to implemented processes. However, models show large constraints in reproducing the complexity of species rich ecosystems, which limits their comparability with empirically observed patterns. The concept of Plant Functional Types (PFT) provides a possible solution to this problem. It allows for the translation of species diversity into functional diversity, reducing complexity in empirical pattern. Concurrently, applied in stochastic simulation models, the PFT approach permits to detect mechanisms underlying observed biodiversity patterns. We simulated grassland diversity in relation to land use regime with an individual based spatially explicit model. In addition we analyzed vegetation data sampled along the land use gradient of the Biodiversity Exploratories. Plant species were translated into model PFTs via traits from databases such as LEDA. Results showed that this combined approach provides an excellent tool to test alternative hypotheses of drivers and mechanisms maintaining functional diversity in grasslands.



### Drivers of parasitoid foraging behaviour under field conditions

Clara-Sophie van Waveren<sup>1</sup>, Katrin Meyer<sup>1</sup>, Kerstin Wiegand<sup>1</sup>, Martijn Bezemer<sup>2</sup>

<sup>1</sup> Ecosystem Modelling, University of Goettingen

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Parasitoids are known to use volatiles from the host, from the host plant, and from the microhabitat as cues to locate suitable hosts. In the field, parasitoids respond not only to the source of volatiles but also to host density. In addition, the structure and diversity of a habitat can physically affect parasitoid movement, conceal host plants or obscure chemical cues used for host location. We developed a spatially explicit pattern-oriented simulation model to determine the influence of host density, patch size, volatile emission, and habitat complexity on the foraging behaviour of female and male parasitoids. The model is based on two release-recapture field experiments with the tritrophic system *Brassica nigra*, *Pieris brassicae*, and *Cotesia glomerata*. The central model parameter is parasitoid searching efficiency, which is influenced by the source of chemical cues, experience, the strength of attraction, wind speed, flying speed, and habitat structure. The model helps to identify the relative importance of attraction by volatiles as compared to other biotic and abiotic factors under field conditions. First results indicate the central role of attraction for male and female foraging behaviour.



## **Inference from Data in Complex Models: A Bayesian Approach**

*Joseph Chipperfield*<sup>1</sup>, Thomas Hovestadt<sup>1</sup>

<sup>1</sup> Field Station Fabrikschleichach, University of Wuerzburg

Scientists strive for simplicity in their models. Ecological phenomena are complex however, and simple models can sometimes prove inadequate. Complex models have many costs; many do not have elegant mathematical descriptions and rely on simulations for the purposes of analysis and fitting. Here I describe a series of methods for incorporating data into these models using a set of individual-based models for describing the spatial dynamics of molehill production as an example.



## **A data portal for a Biodiversity Ecosystem Functioning research unit**

*Karin Nadrowski*<sup>1</sup>, Christian Wirth<sup>1</sup>

<sup>1</sup> Special Botany and Functional Biodiversity, University of Leipzig

Ecological Research Units collect a diverse range of different data, which the individual projects want to keep and share at the same time. Sharing data has to include sharing of meta-data, informing (re)-users about methods used to collect and/or aggregate data. Although standards are available, they have not yet found wide acceptance in the ecological community. Here we present the data portal of the DFG-research unit BEF-China (Biodiversity - Ecosystem Functioning, FOR 891), including our efforts to adhere to ecological data standards (Ecological Metadata language), the software we use (Ruby on Rails), and the experience we so far had with user interaction. We outline future directions of our data portal towards semantic annotation of data.



POSTER PRESENTATION:

**The intelligent plant: Paradox or ecological reality?**

Katrin Meyer<sup>1,4</sup>, Leo Soldaat<sup>2</sup>, Harald Auge<sup>3</sup>, Hans-Hermann Thulke<sup>4</sup>

<sup>1</sup> Ecosystem Modelling, University of Göttingen

<sup>2</sup> Statistics Netherlands

<sup>3</sup> Department of Community Ecology, UFZ-Helmholtz Centre for Environmental Research

<sup>4</sup> Ecological Modelling, UFZ-Helmholtz Centre for Environmental Research

Behaviour is traditionally attributed to animals only. Recently, evidence for plant behaviour is accumulating, mostly from plant physiological studies. Our aim was to provide ecological evidence for plant behaviour and, more specifically, for the ability of plants to evaluate costs and benefits and to make corresponding decisions. We analysed seed abortion patterns of *Berberis vulgaris* plants including parasite-host-interactions and environmental stress. We tested two mortality models with Monte-Carlo simulations. Seed abortion in stressed or parasitized fruits occurred with significantly greater probability if there was a second intact seed in the fruit. Seed abortion in barberry plants was found to be selective with respect to outer conditions such as parasitism or drought stress, but also adaptive to inner conditions. We provide ecological evidence for the ability of plants to make complex cost-benefit evaluations and corresponding abortion decisions. This adaptive selective behaviour contains the major ingredients of intelligent behaviour: structural memory (the second seed), simple reasoning and cost-benefit analysis (integration of inner and outer conditions), decision-making (abortion), and predictive evaluation of future fitness loss.



## SESSION 21 – BIODIVERSITY AND SOCIETY

CONVENOR: MARGHERITA GIORIA

ORAL PRESENTATIONS:

### On the notion of ecological justice

*Stefanie Glotzbach*<sup>1</sup>

<sup>1</sup> Sustainability Economics Group, Leuphana University of Lüneburg

The increasing loss of ecosystem services severely affects life perspectives of today's poor and future persons (MEA 2005). Thus, the question of just institutions governing the use and distribution of ecosystem services is an urgent issue. Although the concept of ecosystem services has become a core object of study in ecology and ecological economics, it has not been explicitly applied to questions of justice. Developing a philosophically well-founded conception of justice with regard to ecosystem services is important to advance conceivability of the aim of ecological justice and its applicability to concrete policies. To yield a conception of ecological justice, I elaborate on the specific link between justice and ecosystem services. I identify five demands on a concept of ecological justice: global and intertemporal extension of the community of justice, classification of ecosystem services as objects of justice, reference to institutional justice, separability of needs and wants, and embedding in conceptions of social justice. I investigate whether these demands can be addressed by Rawls' "Theory of Justice" (1971), Utilitarianism (Mill 1863 & Birnbacher 1988) and Communitarian theories of justice (De-Shalit 1995 & Walzer 1983), and which intragenerational and intergenerational principles of justice follow from them. Finally, I illustrate the resulting conception of ecological justice by the example of EU fisheries policy.



**Marrying forest biodiversity conservation strategies with indigenous peoples cultural beliefs in the climate change era: Glimpses from Guyana and Ghana**

*John Cartey Caesar*<sup>1</sup>

<sup>1</sup> Department of Biology, Faculty of Natural Sciences, University of Guyana

Indigenous knowledge is imbued with human understanding of, interdependence and interaction with nature. The roles of cosmology, taboos, folklore, spiritualism, religion, ethnoecology, among others, together provide a holistic view of the role of indigenous knowledge in ecologically sustainable development and the maintenance of ecological integrity of the biosphere. Culture, in its widest sense, is the hallmark of mankind's superiority in the animal kingdom. An important socioecological construct. On face-value, indigenous knowledge may be perceived as primitive attitudes, lifestyles, thinking, and beliefs. We provide corollaries of forest dwellers' beliefs in the mystique of the forest and its biodiversity. Emerging views of how best we can adapt and formulate some of these cultural beliefs and related socioecological constructs into adaptive management paradigms for meeting the needs of climate justice under current forest governance practices under the REDD+ mechanism for climate change mitigation in Guyana and Ghana are highlighted. Cultural beliefs among our indigenous relatives may represent unique systems of ethnoconservation strategies to safeguard forest ecosystems in Guyana, Ghana and elsewhere.



**The economic importance of non-timber forest products for livelihood maintenance of rural communities in Westafrican savannas: A case study from Benin**

*Katja Heubach*<sup>1</sup>, Rüdiger Wittig<sup>2</sup>, Karen Hahn-Hadjali<sup>2</sup>

<sup>1</sup> Biodiversität und Klima Forschungszentrum

<sup>2</sup> Geobotanik, Uni Frankfurt

As provisioning ecosystem services of Westafrican savannas non-timber forest products (NTFPs) make a significant contribution to household income in rural African communities. Undertaking a livelihood approach focussing on multi-purpose useful plants our study aims to identify their respective share in a household's total income in order to elicit the strong interrelation between local natural resource use and livelihood maintenance. We interviewed a total of 230 households across five different ethnic groups (Fulani, Ditammarie, Yom, Kabié and Bariba) comparing two villages in Northern Benin, Papatia and Chabi-Couma. Coevally, data on the economic value of the studied NTFPs was gathered by conducting market surveys as well as applying participatory rural appraisal techniques. At present we are applying simple choice experiments due to investigate individual preferences concerning both direct use values and cultural / spiritual values of the studied plant species. The results of the livelihood approach will reveal the unquestionably high economic importance of biodiversity provided by savannas that has been largely discounted by local policy-makers deciding whether to shift long-standing forest into agricultural land. Findings will be used to assist with appropriate decision making.



**An integrative ecological approach towards insect conservation in a Mediterranean agricultural landscape: The case of Insect (Odonata) fauna in the Maltese Islands**

*Mario V. Balzan*<sup>1</sup>

<sup>1</sup> Malta College of Arts, Science and Technology

An integrative ecological approach to the assessment of conservation of insect groups within highly modified Mediterranean agricultural landscapes is proposed. A hierarchical multiscale analysis was carried out and investigated how habitat characteristics at multiple scales, ranging from the immediate habitat structure to the local agricultural landscape characteristics, influence a target group (Insecta: Odonata) distributions. Multivariate statistical procedures were used to analyse the relationship between Odonata assemblage patterns and environmental variables. Moreover, stakeholders were considered as an inherent part of the landscape, and consequently local ecological knowledge together with stakeholders' perception of insect conservation was carried out. Results from this study suggest that Odonata populations are influenced by habitat characteristics at multiple scales, ranging from the physical properties and characteristic vegetation to landscape composition and diversity. Concurrently, this study identified farmers' perception of insects in agricultural landscapes, their conservation, cause of decline of 'beneficial' species, and persistent pest problems arising from resource management actions. Grounded in these findings, an iterative and integrative ecosystem-based management approach is proposed for the conservation of insect species in the agricultural landscapes.



**Moral concerns about the use of GM crops: A review of scientific publications in the field of ecology and environmental ethics***Daniel Gregorowius<sup>1</sup>*<sup>1</sup> Institut für Evolutionsbiologie und Umweltwissenschaften (IEU), Universität Zürich

In 2008, a systematic literature review of 18 scientific journals (245 articles) in the field of ecology, environmental ethics, and interdisciplinary sciences was carried out to provide a first comprehensive overview of the moral concerns expressed in scientific publications on the use of genetically modified plants in commercial agriculture (GM crops). Consequentialist concerns were most prominent in the assessed literature. Almost 90% of all articles mentioned or discussed specific ecological consequences of the introduction of GM crops or expressed general ecological and risk concerns. Articles that included deontological concerns (25%) dealt with the value of naturalness and the value of living entities, and articles that included virtue concerns (15%) pointed to virtues about the handling of risks and virtues about the application of GM crops. Consequences of the release of GM crops for species or ecosystems were mentioned in 80% and consequences for (agro) biodiversity in 29% of all articles. However, very few of these articles discussed the relevance of biodiversity from a moral point of view. This indicates that the scientific discourse does not reflect the concerns of the general public, as for laypersons moral aspects of biodiversity are very important. Tools are needed to bridge this gap in order to guarantee a rational decision-making when dealing with GM crops and biodiversity conservation.



**Young people's perception of different habitats in botanical gardens**

*Katrin Lückmann<sup>1</sup>, Verena Lagemann<sup>1</sup>, Susanne Menzel<sup>1</sup>*

<sup>1</sup> Didactics of Biology, University of Osnabrueck

Botanical gardens have a large potential to include biodiversity issues into their educational programs. In order to tap this potential, the German National Strategy on Biological Diversity suggests developing botanical gardens to focal points of biodiversity education. However, the educational potential of botanical gardens is still an under-investigated topic. For example, botanical gardens vary between more systematic-geographical-orientated habitats (SGOH) with a certain structure, and more nature-orientated habitats (NOH). It would be interesting to investigate young people's preferences of such habitats, to be possible to decide which learning environments are most suitable for biodiversity education. As theoretical framework we used the Scenic Beauty Estimation Theory (SBE), i.e. an aesthetic assessment of landscapes. We conducted a qualitative interview study in two differently designed areas of the Botanical Garden of Osnabrueck University. 28 pupils aged 13-15 were asked to evaluate two areas in the exemplary garden. The results indicate that the SGOH was preferred over an NOH area. Moreover, the statements of the pupils indicate that they prefer horticultural well-kept areas in which, for example, withered plants are taken out. At the same time, pupils negatively evaluated elements that they perceive as too artificial.



**Young Adolescents arguments about recurring wild animals in Germany**

*Nadin Hermann*<sup>1</sup>, Susanne Menzel<sup>1</sup>

<sup>1</sup> Didaktik der Biologie, Universität Osnabrück

Whenever wild animals return to human-inhabited areas, acceptance of these animals is a critical issue. If we want to enhance such an acceptance, young people are an important target group. However, to date little is known about the perspectives of young adolescents towards recurring wild animals. To close this gap in research, we conducted a qualitative interview study. Thirty-one adolescents from different regions participated in our study. Chosen regions were affected regions, in which wild animals are currently recurring and 'neutral' regions for comparison. We used the Protection Motivation Theory (Rogers & Prentice-Dunn 1997) as a theoretical basis. As a consequence, the interviews followed an interview guide which focused on the threat- and coping appraisals of two possible threat perceptions: threats caused by the respective animals and threats to the animal by risking its extinction. Threats were differentiated into three conceptual categories: threat to oneself and to other people or threat to the ecosystem (Schultz 2001). Our interviews focused especially on the wolf and the European bison as examples of recurring wildlife. However, interviews also included other wild animals, depending on test-persons' statements. First findings indicate that a majority of our participants had a strong moralistic view on wildlife. Their reasoning for supporting wildlife and their acceptance of wildlife management measures were often characterized through ethical argumentations.



**What do biology teachers know about the distribution and loss of biodiversity?  
Perspectives from a biodiversity hotspot (Costa Rica) and an industrial country  
(Germany)**

*Florian Fiebelkorn*<sup>1</sup>, *Susanne Menzel*<sup>1</sup>

<sup>1</sup> Didactics of Biology, University of Osnabrück

Pre-service teacher education has been regarded as particularly important for spreading and implementing innovations, such as biodiversity education. To date, there is little empirical evidence on pre-service teachers' knowledge and perspectives. Moreover, if we regard the topic of biodiversity loss globally, perspectives may strongly differ between future teachers living at a Biodiversity Hotspot like Costa Rica from those in industrialized countries, such as Germany. Hence, our main research question is as follows: Which perspectives and knowledge can be identified among German and Costa Rican pre-service biology teachers concerning the terminology, distribution and loss of biodiversity? Data stems from an exploratory qualitative interview study (n = 24). Both verbal and visual methods were used to elicit responses. We primarily followed the method of qualitative content analysis. The theoretical background is based on the assumptions of constructivism and cognitive frameworks. We found participants to equate biodiversity with species diversity and to have misconceptions about genetic diversity. Furthermore Costa Rican students seem to have a more "local-figurative" view on biodiversity, whereas German teachers have a more "global-abstract" idea of biodiversity. Participants from both countries implicitly use naive "Biodiversity Hotspot" and "Wilderness Area" concepts to explain the distribution and loss of biodiversity, although the scientific concepts are not known.



**From Haeckel to ecological modelling - vifabio as a guide to scientific ecology in libraries and on the internet**

*Gerwin Kasperek*<sup>1</sup>, Judith Dähne<sup>1</sup>

<sup>1</sup> University Library, Goethe University Frankfurt

The Virtual Library of Biology (vifabio) offers centralised access to biological literature and information in libraries and on the internet, with ecology being a major focus. With a single search query in the Virtual Catalogue the catalogues of numerous specialised libraries, the bibliographic data of the Biodiversity Heritage Library and several article databases as well as the vifabio Internet Guide are searched in parallel. Depending on supplier and on the location of the user direct online access to the full text is possible in many cases. In other cases, document delivery services offer access to the literature. During the presentation, the benefits of using vifabio for ecological retrieval problems will be shown in detail. For example, the Virtual Catalogue will provide, with just a single query, a wide range of results, encompassing Haeckel's works, many works about Haeckel including the most recent journal articles, and the most important web sites about Haeckel. In vifabio's Internet Guide, a special service for online resources, there is a wide variety of tools to find information about ecological modelling as well as many other hot topics in ecology.

PS: You are invited to visit our demonstration desk at the GfÖ conference and check out vifabio's online services (<http://www.vifabio.de>). We would be glad to hear your comments and ideas regarding digital library services in general and vifabio in particular.



POSTER PRESENTATIONS:

**The traditional knowledge of the Csángó peoples – Ethnogeobotanical studies in Gyimes**

*Daniel Babai*<sup>1</sup>, Zsolt Molnar<sup>2</sup>

<sup>1</sup> Institute of Ethnology

<sup>2</sup> Institute of Ecology and Botany

We carried out our researches in the Gyimes region of the Eastern Carpathians. The investigated community has about 1200 members. The goal of our research was to explore the botanical knowledge of the locals. We can claim that people in Gyimes know and can name 280 species from the 453 plants identified by us, which makes up 62% of the entire flora. What this stands for is 172 folk taxa as a result of the significant local taxonomy of plants. Also, these people can remarkably characterize the habitat of these species. They connect at least 131 different habitats to the 280 species known by us. The characteristic appearances of the typical habitats and the vegetation of the Gyimes region are well known by the locals. After exploring the Gyimes vegetation by botanical methods we can get a clear picture of the traditional but constantly changing stock-keeping farming's effects on the vegetation as well as the extent to which local people experience the effects of farming on the vegetation. Their knowledge is to our help in estimating the influences of farming on the vegetation and the changes it triggers.



## **Family farm succession and impacts on HNV farming in Transylvania, Romania**

*Krystyna Larkham*<sup>1</sup>

<sup>1</sup> Centre for Environmental Policy, Imperial College, London

Family farm succession is the study of how and when a farmer passes the management of his land on to the next generation. This is of particular importance in regions of High Nature Value (HNV) farming, where the nature value of the farmland is reliant on a certain set of management practices.

This study examines the succession practices of small farmers in the Tarnave Mare N2000 site in Transylvania, Romania, and shows that future changes in ownership or management of land are likely to result in sharp decreases in grassland biodiversity in the area. However, short term drivers of change such as economic flux are likely to have a more immediate impact on the nature value of the N2000 site.



**Value and impact of SABI (South African Biosystematics Initiative) in stimulating biosystematics research in South Africa**

*Frank Mazibuko*<sup>1</sup>

<sup>1</sup> Knowledge Fields Development, National Research Foundation

SABI vision is: *to develop a representative community of systematists-well supported by government and society-addressing exciting and important issues relevant to South Africa's rich biological heritage.* This poster analyses the success of the systematics research community in achieving this vision by looking at the funding levels, capacity development and publication as performance indicators and makes future recommendations. Findings from the analyses demonstrate that total funding of R25Million (Euro 5,2million) was invested for systematics research (2005-2008), and capacity building with 203 grant-holder linked bursaries in total—of which 37% were allocated to black students and 53% to female students. SABI has addressed both the decrease of funding to museum based researchers and dwindling capacity which had previously been identified as major problems for biosystematics in South Africa. The majority of the projects funded focused on terrestrial animals and plants, and on aquatic animals (freshwater and marine), predominantly addressing phylogenetics, descriptive research and phylogeography. Peer-reviewed journal article is the preferred source to disseminate research findings. Future recommendation, among others, is a need to design strategies to support black female researchers. To also support projects on marine and freshwater plants/algae, and to encourage internationalisation of South African science as well as public understanding of biosystematics.



**Development of a holistic evaluation method for ecosystem services on a regional scale**

*Claudia Schröder*<sup>1</sup>, Vera Luthardt<sup>1</sup>, Florian Jeltsch<sup>2</sup>

<sup>1</sup> HNE Eberswalde

<sup>2</sup> Universität Potsdam

Many different approaches exist to assess ecosystem services but a general and consistent evaluation method that can be applied to a broad range of applications is still missing. This shortcoming impedes a systematic comparison of results of the numerous studies on ecosystem service assessment worldwide. As a consequence, the realised results remain case-specific and shortcomings are often difficult to detect. Here, we propose a 'holistic' approach to assess ecosystem services under Global Change that can be applied independent from specific system features and that allows to compare results across system boundaries.

Based on the approach by Boyd and Banzhaf (2007), we developed a methodological framework, which includes (1) the identification of the individual demand from stakeholders, (2) the identification of the potential of the examined ecosystem type to provide ecosystem services, (3) the classification of specific final ecosystem services and their intermediate components and (4) the indicator-based evaluation of all identified ecosystem services and their intermediate components. The proposed framework is currently applied to selected ecosystem types in Northeast Germany using case studies on local and regional scale.

Results of the proposed approach can also serve as a decision support tool to weigh up land use options and management options in planning processes especially in the context of sustainability, climate change and efficient use of subsidies.



## **The Pogány-havas (Pagan Snow Cap) Region**

*Robert Biro*<sup>1</sup>, *Gergely Rodics*<sup>1</sup>

<sup>1</sup> Pogány-havas (Pagan Snow Cap) Association

The Pagan Snow Cap regional association established in 1999 is made up of the Harghita County Council and next seven settlements: Csíksomlyó, Csíkpálfalva, Csíkszentmihály, Csíkszépvíz, Gyimesfelsőlók, Gyimesközéplek and Gyimesbükk. Gyimesbükk is located within Bacau county while the rest belong to Harghita county.

### **Mission**

Our mission is to improve the quality of life of locals by respecting natural values and traditions.

### **Activities**

Our main goal is to initiate and execute rural development in the area, paying special attention to:

- Environment
- Agriculture
- Tourism
- Cultural heritage and traditions

... in continuous co-operation with local citizens.

We are working with scientists and NGOs to catalogue and conserve the special animal and plant life of the region, especially in its wetlands and hay meadows.

We support traditional agriculture and boost farm incomes through training programmes and study tours for farmers, encouraging development of new dairy products, providing information about ecological farming and organic conversion, and helping farmers' associations to increase the quality of their milk through ownership of milk collection and testing equipment.

We encourage tourism in the region by offering a booking and information service, working with guesthouse owners, producing tourist information, and organizing a tourism round-table for local entrepreneurs...



## **Costs and benefits of alternative arable production systems in Kosovo – An ecosystem services approach**

*Iliriana Miftari*<sup>1</sup>, Mujë Gjonbalaj<sup>1</sup>

<sup>1</sup> Agroecology Department, Agriculture and Veterinary Faculty, University of Prishtina

The agricultural production systems of arable farming in Kosovo are mainly focused on the production function, whereas other functions such as societal and ecological functions are not or rarely taken into consideration. As in many other regions, the production intensity has been strongly intensified with respect to external inputs. The production system alteration resulted in a decreased ability of agricultural landscapes suitable to support e.g., biodiversity. Even though food production is essential, the arable production systems in Kosovo require new approaches, in order to meet societal and ecological targets. Starting in autumn 2010, a study on agricultural sustainability in Kosovo will be conducted. The overall objective of the study is to economically evaluate the effects of an array of today's arable production systems in Kosovo on (a) farmers' income, (b) regional value added, (c) regional social welfare, and (d) nature and the environment. The evaluations will refer to the ecosystem services concept and will consider all the four categories of services. The evaluations of farmers' income and regional value added will be based on real and potential prices of agricultural products (private goods). The regional social welfare (public good) will be estimated based on the well established tool of cost-benefit analyses. The evaluation of the effects on nature and the environment (public goods) will consider the money needed to reduce or counteract environmental pollution and biodiversity threat resulting from the investigated arable production systems (by implementing e.g., agri-environment schemes). Based on the gained results, suggestions on how to foster the degree of agricultural sustainability will be derived.



## **SESSION 22 – IMPROVING THE GLOBAL AND NATIONAL SCIENCE-POLICY INTERFACE ON BIODIVERSITY - INSTRUMENTS AND APPLICATION**

**CONVENOR: CARSTEN NEßHÖVER, KATRIN VOHLAND**

### ORAL PRESENTATIONS:

#### **The structure of IPBES as an international science-policy interface**

*Axel Paulsch*<sup>1</sup>, Carsten Neßhöver<sup>1</sup>, Christoph Görg<sup>2</sup>

<sup>1</sup> Conservation Biology, Helmholtz-Centre for Environmental Research - UFZ

<sup>2</sup> Environmental Policy, Helmholtz-Centre for Environmental Research – UFZ

In June 2010, an intergovernmental meeting convened by UNEP has decided to set up an Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), following the successful approach of the IPCC in the climate change context. The main aim is to improve the scientific input into international and regional biodiversity policy. The question arising from this is, how such a platform should be designed in detail in order to ensure its policy relevance on the one hand, and its scientific independence on the other. For biodiversity policy, this aspect is even more complicated by the fact that many decisions relevant for biodiversity on the global scale are made on the local scale. The talk will give an overview on the most recent discussions in the field, on the one hand on the political side, but also from the view of governance research.



## The biodiversity research landscape in Germany

*Elisabeth Marquard*<sup>1</sup>, Katrin Vohland<sup>2</sup>, Markus Fischer<sup>3</sup>

<sup>1</sup> University of Potsdam; Helmholtz Centre for Environmental Research – UFZ

<sup>2</sup> Museum für Naturkunde

<sup>3</sup> University of Bern; University of Potsdam

Biodiversity research tackles questions about the origin, status and change of biological diversity as well as questions about its relation to human well-being, its conservation and sustainable use. Therefore, biodiversity research is of ecological, economic and societal importance. However, an empirically based overview about its status and perspectives in Germany has rarely been compiled. Using the internet, an online-questionnaire, and Web-of-Science queries, we gathered information about current biodiversity research to which German institutions contribute. Focusing on ecological research, our aim was to a) describe the German biodiversity research landscape b) analyse the origins and directions of its financial support and c) test empirically some of the theses about German biodiversity research that were recently put forward by a working group of the German research foundation (Fischer et al. 2008). To point out needs and perspectives, we compared the identified strengths and weaknesses of German biodiversity research with measures and actions concerning biodiversity science that have been sanctioned by the German government as part of Germany's National biodiversity strategy (BMU 2007). We concluded that German biodiversity research contributes at high levels to the understanding of patterns and functions. However, a broadening of the research to even more organism groups, ecosystems and geographic regions and a stronger cross-linking between disciplines seem desirable.



**Network-Forum Biodiversity Research Germany – Instruments to increase political impact of biodiversity research**

*Katrin Vohland*<sup>1</sup>, Carsten Neßhöver<sup>2</sup>, Axel Paulsch<sup>2</sup>, Elisabeth Marquard<sup>2</sup>, Sebastian Tilch<sup>2</sup>, Christoph Häuser<sup>1</sup>

<sup>1</sup>Museum für Naturkunde

<sup>2</sup>Helmholtz Centre for Environmental Research – UFZ

The importance of biodiversity as foundation of human well being and development is widely acknowledged. However, the missing of the 2010 biodiversity targets is now officially acknowledged. Hence, biodiversity research can contribute at different scales and contexts to develop and reach post-2010 biodiversity.-Internationally, the implementation of an intergovernmental science-policy Platform on Biodiversity and Ecosystem Services is debated. In Germany, the German Ministry of Education and Research (BMBF) supports the Network-Forum Biodiversity Research Germany ([www.biodiversity.de](http://www.biodiversity.de)) as a project within the frame of DIVERSITAS Germany. The most important function is to inform the biodiversity research community and political and other stakeholders about each others' activities and results. As biodiversity research itself is already extremely divers, researchers and institutes can introduce themselves and their work in a joint forum at the website. Events and actual news are posted. For special topics and emerging issues (e.g. Tipping Points, LifeWatch) dedicated workshops are organized to discuss overarching (research) questions and to develop draft position papers. Reports from political processes are prepared to make research and communication gaps visible and concrete funding opportunities are highlighted. However, the real strength of the network relies on the active participation and exchange by many individuals and partners, which therefore is hereby openly encouraged.



## **The German National Programme on Biodiversity – First cornerstones**

*Andreas Krüß*<sup>1</sup>

<sup>1</sup> Federal Agency for Nature Conservation, Germany

The new German government has decided to set up a national programme on biodiversity to support the implementation of the National Biodiversity Strategy (NBS). With the programme innovative projects shall be funded, aiming at developments of approaches and their application. On the 3<sup>rd</sup> national Forum on Biodiversity on the 27<sup>th</sup> of May, 2010, first cornerstones of this programme had been presented by the German Environmental Minister Norbert Röttgen and a stakeholder consultation process was started to further develop the outline of the programme. The results will be presented end of September at the National Conservation Conference (Deutscher Naturschutztag, Stralsund).

Currently, 4 main topics are planned for the programme: Support of species with special national responsibility; Support for Hotspot-Regions of Biodiversity in Germany; Safeguarding of ecosystem services, and finally measures of specific relevance of the NBS. The conceptual basis of these topics now needs to be further developed, especially from the conservation point of view.

The talk will be given in German.



**The German National Programme on Biodiversity – Reflections from a scientific point of view**

*Carsten Neßhöver*<sup>1</sup>

<sup>1</sup> Conservation Biology, Helmholtz-Centre for Environmental Research - UFZ

The national programme on biodiversity will be an important contribution of the National Biodiversity Strategy in the next years. With its topics on “national responsibilities”, “hotspots” and “ecosystem services”, the programme builds upon well established, but also some still very dynamic concepts from a scientific point of view. Thus it will be important, that implementation projects are including most recent scientific knowledge and/or that the programme also identifies and tackles research gaps to complement the implementation projects. For example, the concept of ecosystem services is currently discussed from very different perspectives, but its suitability for the German context, including nature conservation and environmental law, needs further scientific analysis.

The talk will present interim results from a report from the scientific community on the national programme and invites experts to join this ongoing discussion.

The talk will be given in German.



## SESSION 23 – ECOLOGICAL RISKS

CONVENOR: JULIANE FILSER

ORAL PRESENTATIONS:

### **Cassava biodiversity, starch extraction from Cassava tubers in South India and related environmental problems**

*Gero Benckiser*<sup>1</sup>, Soora Maya<sup>1</sup>, Rajendran Ranjithkumar<sup>1</sup>, Kandasamy Sujatha<sup>2</sup>, Dananjeyan Balachandar<sup>2</sup>, Krishnamurthy Kumar<sup>2</sup>

<sup>1</sup>Institute of Applied Microbiology, Justus Liebig University, Giessen, Germany

<sup>2</sup>Department of Agricultural Microbiology, Tamil Nadu Agricultural University, Coimbatore, India

In tropic and sub-tropic countries Cassava tubers containing 35% starch are staple food for ca. 500 million people. In the region around the South Indian city Salem, Tamil Nadu around 1000 factories extract starch by using 30.000 to 40,000 litres groundwater per tonne (daily average production per factory 5 t starch granulated to sago). Accordingly the around 1000 sago factories in the region of Salem have to pump daily 150 to 200 million litres groundwater out of 80 m depth and contribute largely to the continually decreasing groundwater level in this monsoon governed region (rainfalls July to September, the rest of the year dry and hot). Simultaneously, huge amounts of highly organic enriched, cyanid containing waste waters are mostly untreated released into the environment, partly used for irrigating adjacent fields. Not only odd smells are registered but also ground and surface waters and the soil fertility are impaired. Governmental regulations and the mentioned environmental impacts have sago factory owners convinced to treat their wastewaters and they have started to install them.

In a BMBF- und DST- (Department of Science and Technology, India) financed co-operation we have studied the chemical and microbial changes in 3 differently dimensioned biogas plants and will report about cassava production, starch extraction, and microbial shifts in the waste water with CN ratios of about 250 as well as about future strategies helping to reduce landscape impacts.



**Reproductive potential of oilseed rape (*Brassica napus* L.) and its relatives on ruderal sites – Implications for GMO risk assessment**

Jana Seeger<sup>1</sup>, Broder Breckling<sup>1</sup>, Juliane Filser<sup>1</sup>

<sup>1</sup> Department of General and Theoretical Ecology, University of Bremen, UFT Centre of Environmental Research and Sustainable Technology, Bremen, Germany

Risk assessment of genetically manipulated oilseed rape (*Brassica napus*) requires an estimate of its potential to develop self-sustaining feral (wild) populations. Yet little is known about the magnitude of establishment success in ruderal settings and about how this compares to the performance of weedy relatives. We therefore assessed establishment and reproductive potential of *B. napus* and *B. rapa* in comparison with their weedy relatives *B. nigra* and *Raphanus raphanistrum* in a one-year field study. Plant performance was tested on four ruderal substrates on a former rubble dump site in Bremen, Germany. A fully factorial two-way split-plot design was used. Low-quality soils reduced the reproductive potential of the cultivated plants *B. napus* and *B. rapa* significantly, but had little or the opposite effect on the wild relatives. However, the cultivated plants produced substantially more fruiting individuals than the weedy plants on each substrate and nearly always produced more seeds per seed sown. We thus demonstrated that a cultivated plant such as *B. napus* can be just as successful under ruderal soil conditions as weedy relatives. This raises concern for the uncontrolled spread of transgenes from GM plants via ruderal populations.



**Effects of genetically modified wheat on annelids***Andreas Lindfeld*<sup>1</sup><sup>1</sup> Institute of Ecology and Evolution, University of Bern

In recent years a multitude of studies have been done to evaluate potential risks of genetically modified (GM) plants on the environment. Focus lay on non-target organisms such as decomposer fauna, which contribute to essential ecosystem services. We analysed effects of GM wheat on enchytraeids as well as lumbricids as important model decomposer. We used GM wheat with either specific resistance against powdery mildew (*Blumeria graminis*) or unspecific resistance against fungi via chitinase and glucanase expression. Results of the encytraeid study indicate that effects due to specific resistance are either absent or too weak to affect number of surviving adults or number of offspring in a relevant way, but t. Though, chitinase and glucanase expression affect number of surviving adults negatively. Comparison of five conventional wheat varieties revealed significant differences in number of surviving adults, too. Since these differences were as big as the effect of glucanase and chitinase expression, it is questionable whether the found negative transgenic effect is of ecological relevance or whether other biotic and abiotic factors are more important. Analysis of plant compound composition showed no differences between transgenic and non-transgenic wheat varieties. No correlation to number of surviving adults or number of offspring was observed.



**Cereal aphids, powdery mildew and transgenic disease-resistant wheat - Indirect effects of GM wheat through insect pathogen interactions**

Simone von Burg<sup>1</sup>, Fernando Alvarez<sup>2</sup>, Jörg Romeis<sup>2</sup>

<sup>1</sup> Institute of Evolutionary Biology and Environmental Studies, University of Zürich

<sup>2</sup> Agroscope Reckenholz-Tänikon Research Station ART

Ever since the introduction of genetically modified (GM) crops one of the concerns has been their effect on non-target organisms. Agroecosystems are characterized by numerous insects as well as by various pathogen species which are all involved in complex interactions. In ecology such interactions have always gained attention; so has the introduction of GM crops. We looked at the effect of transgenic powdery mildew-resistant wheat on two cereal aphids, *Metopolophium dirhodum* and *Rhopalosiphum padi*. We hypothesised that alterations in the metabolism of the GM plants affect the aphids directly but were also interested in the indirect effect of the GM plants through the presence/absence of the fungal pathogen. We investigated our hypotheses using various experimental approaches and systems. We did not find evidence for a direct effect of the introduced transgene on a range of life-history traits of *M. dirhodum*. However, we did find a presumably indirect, positive GM wheat effect on *M. dirhodum* mediated by the mildew resistance. Aphids on mildew infected plants performed worse compared to aphids feeding on non-infected plants. *Rhopalosiphum padi* was not affected by the pathogen. These results were consistent to those observed under field and semi-field conditions. Summarizing we can say that the introduced trait influenced aphid abundance and performance rather than the transgene itself and we conclude that disease-resistant GM plants have the potential to shape insect communities through altering insect-pathogen interactions.



**The role of deposited aerosols for plant ecophysiology***Jürgen Burkhardt*<sup>1</sup><sup>1</sup> INRES- Plant Nutrition, University of Bonn

Aerosols have always been part of the atmosphere, and plant surfaces are a major aerosol sink. Given the nutrient content of aerosols and the natural stability of aerosol concentrations over evolutionary time, plants may have developed adaptations to aerosol input, probably by leaf surface micro-roughness. Most of the fine aerosols (diameter less than 2.5  $\mu\text{m}$ ) are hygroscopic, and they are often deliquescent on transpiring leaves. Such concentrated solutions may be taken up by both the cuticle and stomata, contradicting previous concepts. The establishment of a continuous liquid water connection along stomatal walls affects individual stomata and is a new concept called “hydraulic activation of stomata” (HAS). HAS enables the efficient bidirectional transport of water and solutes between the leaf interior and leaf surface and makes stomatal transpiration partly independent of stomatal aperture. The response of plants to changes in humidity can be explained by the split transpiration in an HAS pore and its interaction with neighboring stomata, i.e., as an emergent property of a stomatal patch. Normally, HAS affects only a few stomata, but if too many are activated, hygroscopic particles may work as “desiccants,” reducing the drought tolerance of plants. Excessive particle accumulation may e.g. be caused by air pollution. It is hypothesized that deliquescent hygroscopic particles, due to their amorphous appearance, may have been misinterpreted as “degraded waxes.”



**Why should nanotechnology bother ecologists?***Juliane Filser<sup>1</sup>*<sup>1</sup> Allgemeine und Theoretische Ökologie, Universität Bremen, UFT

Nanoparticles are particles below 100 nm in size. Their chemical composition and shape are highly variable, and both determine their potential toxicity. In recent years, the development of products containing nanoparticles has exponentially increased. Hundreds of products such as colours, clothing, cosmetics, computer displays or food contain these minute particles. Their release to the environment increases accordingly – however, hardly anything is known about potential risks. Existing studies do raise concern: depending on their respective properties, nanoparticles have caused negative effects to vertebrates, invertebrates, plants and in particular microorganisms. I will summarise studies that have been carried out in our group, with a focus on metal nanoparticles. We demonstrated negative effects on bacteria, algae, plants, Collembola and earthworms. Moreover we showed that trophic interactions are crucial for assessing environmental risks: in presence of predators, silver nanoparticles had considerable negative effects, which were not visible (or even positive) in their absence. Our present research concentrates on the development of environmentally friendly metal (oxide) nanoparticles. For that purpose we cooperate in two large interdisciplinary projects with partners from science, industry and regulation authorities.



## **SESSION 24 – NATURE CONSERVATION AND SUSTAINABLE MANAGEMENT: CONCEPTS, STRATEGIES AND EXAMPLES**

**CONVENOR: NINA FARWIG, ILONA LEYER**

ORAL PRESENTATIONS:

### **Species conservation in protected areas under climate change: Problems, trends and future needs in scenario development and forecasting**

*Mungla Sieck*<sup>1</sup>, Jeltsch Florian<sup>1</sup>, Ibisch Pierre<sup>2</sup>

<sup>1</sup> University of Potsdam

<sup>2</sup> University of Applied Sciences Eberswalde

Protected areas are the most common and most important instrument for the conservation of biological diversity and are called for under the United Nations' Convention on Biological Diversity. It is of crucial importance to include possible impacts of climate change into future nature conservation strategies and protected area management if we want to preserve today's biodiversity in the long run. The enhanced progress in computer capacities has been utilized for species modeling and is increasingly applied in the field of conservation biology. The development and improvement of climate models have facilitated the incorporation of climate change projections into species models and conservation strategies posing also opportunities to examine potential impacts of predicted climate change on protected areas. The increasing number of scientific publications on the topic has motivated us to conduct a thorough literature review on the topic of terrestrial protected areas under climate change with a focus on current modeling approaches to evaluate and detect trends and gaps in this field. The results show that most studies apply statistical bioclimatic envelope models and only very few a mechanistic process-based approach. These findings clearly illustrate the need for further development and improvement of future computer simulations in order to assess the implications of climate change for protected area effectiveness and management strategies.



## **Long-term conservation and promotion strategies for the arable plant vegetation in Germany**

S. Meyer<sup>1</sup>, T. van Elsen<sup>2</sup>, M. Dieterich<sup>3</sup>, J. Metzner<sup>4</sup>, C. Leuschner<sup>1</sup>

<sup>1</sup>Albrecht-von-Haller-Institute for Plant Sciences, Department of Plant Ecology and Ecosystems Research, University of Göttingen, Göttingen, Germany

<sup>2</sup>University of Kassel-Witzenhausen, Department of Organic Farming and Cropping Systems, Witzenhausen, Germany

<sup>3</sup>Institute of Landscape Ecology and Nature Protection, Singen, Germany

<sup>4</sup>German Association for Landcare (DVL), Ansbach, Germany

There is scarcely any ecosystem which has so markedly been influenced by human activity as agricultural habitats. In recent decades, increasing economic pressure on agriculture and the resulting refinement of weed control measures has led to unprecedented losses of species in agriculture landscapes.

The project "100 Fields for Diversity" aims to establish a network of protected areas for the preservation of endangered segetal species/communities in Germany. Management aimed at preserving and fostering arable wild plants is to be guaranteed in the long term on suitable arable sites.

For land purchase and management, a mixture of instruments from agri-environmental schemes, funds from the intervention/compensation provisions and specific instruments from the German federal states appears to be adequate for safeguarding the fields and ensuring appropriate management methods. Only a long-term financial commitment will ensure the support of farmers. This is one of the main causes of the failure of most former field margin strip schemes, which depend on regular renewal of the temporary agri-environmental programmes. In addition, networking and the exchange of ideas are of crucial importance, because even under non-intensive farming, inappropriate management can lead to losses of the special species assemblages. Currently almost 25 conservation fields were established in Germany.



## **Promoting farmland birds in high-intensity agricultural areas: From occurrence data to landscape management**

*Pedro J. Leitão*<sup>1</sup>, Carsten F. Dormann<sup>1</sup>, Sarah Effertz<sup>1</sup>, Bernd Gruber<sup>1</sup>, Mathias Scholz<sup>1</sup>, Klaus Henle<sup>1</sup>

<sup>1</sup> UFZ - Helmholtz Centre for Environmental Research

Farmland bird population declines have been widely reported over the last 30 years. While agriculture intensification was identified as the primary cause of such declines, economic pressures demand ever increasing crop yields. Indeed, fulfilling concurrent economic and natural requirements constitute perhaps the greatest management challenge towards sustainability. This study thus concentrates on five high-intensity agricultural areas in Saxony and aims at identifying manageable landscape features that satisfy the habitat requirements and therefore promote the occurrence of six farmland bird species. To this aim we applied Boosted Regression Tree models at the state level, using species occurrence and environmental data provided by the Saxon State Ministry of the Environment and Agriculture. The variables that mostly contributed to the models and that can be influenced by landscape management were identified, for further processing. This was followed by a response curve analysis conducted separately for each of the five focal areas, to generate site and species-specific management impact measures. These can potentially be used to promote species occurrence in these intensively used agricultural areas, while maintaining high production yields. Our study thus contributes to further understand landscape management impacts on biodiversity in intensively used regions and this way contribute to biodiversity conservation in landscapes primarily dedicated to agricultural production.



### Experiences from population genetic analyses for regionally focused nature conservation strategies

Birgit Gemeinholzer<sup>1</sup>, Daniel Lauterbach<sup>1</sup>, Michael Ristow<sup>2</sup>, Elke Zippel<sup>1</sup>, Andreas Herrmann<sup>3</sup>

<sup>1</sup> FU Berlin, Botanic Garden and Botanical Museum Berlin-Dahlem

<sup>2</sup> Uni Potsdam

<sup>3</sup> Landesumweltamt Brandenburg

Population genetic structure of 4 endangered plant species in Brandenburg was analyzed to support nature conservation. Twelve individuals per population were analyzed via AFLP technique using 3 different primer combinations, a minimum-compromise between costs, laboratory influences, and statistical requirements. Five populations each from *Scorzonera purpurea* and *Aster linosyris* along the river Oder on a small geographical scale and ten populations of *Scorzonera humilis* and *Scabiosa canescens* from locations all over Brandenburg were sampled. Low population genetic differentiation between geographically close locations (*S. purpurea*, *A. linosyris*) but very high internal population genetic diversity was detected. Here, optimized habitat conservation on any one location results in the preservation of the genetic diversity for all populations of the region; however, without prior knowledge, if this diversity is representative for the whole species. For *S. humilis* and *S. canescens* high genetic population differentiation throughout the sample area could be observed. Neither a phylo-geographic pattern nor a correlation between geographic and genetic distances could be detected. Genetic drift effects in geographically distant populations must account for this. For both species population size was not correlated to genetic diversity. Hence, population history seems to be decisive for preserving genetic diversity on locations with mainly recent declines in numbers of individuals.



**Genetic diversity vs. habitat quality – Effects upon plant fitness in the endangered *Silene chlorantha***

Daniel Lauterbach<sup>1</sup>, Birgit Gemeinholzer<sup>1</sup>

<sup>1</sup> Botanischer Garten & Botanisches Museum Berlin Dahlem, Freie Universität Berlin

For managing endangered plants it is important to consider plant fitness which is affected by genetic diversity and habitat conditions. To analyse the effects of population genetic diversity and habitat conditions upon fitness in different life-cycle stages (seed set, germination, juvenile plants), the highly endangered dry grassland species *Silene chlorantha* in Brandenburg/Germany served as model. Eleven populations were evaluated by measuring, size, density, and coverage. Population genetics were analysed (AFLP). Plant fitness components and population variables were correlated by generalized linear modelling. Population genetic diversity was not correlated to population size and had no effect upon seed set and germination rate. While in nature, seed set was positively correlated to population size - most likely due to higher pollination attractiveness - such correlation could not be observed in the common garden approach, where pollinators were equally available. In nature the number of juvenile plants was negatively correlated to cryptogam coverage and positively correlated to population genetic diversity. In summary, on relatively small geographic scales (e.g. Brandenburg) and suitable habitats the genetic diversity of populations has negligible effects upon plant fitness as long as no inbreeding depression or strong genetic drift took place. Habitat conditions do have stronger effects upon plant fitness, which should be considered for nature conservation activities.



### **Phylogeographical patterns of the noble crayfish (*Astacus astacus*) and recommendations for a regional conservation project in Hessen, Germany**

Anne Schrimpf<sup>1</sup>, Holger Schulz<sup>1</sup>, Ronald Polivka<sup>2</sup>, Christoph Dümpelmann<sup>3</sup>

1 Institute for Environmental Sciences, Universität Koblenz-Landau

2 Bioplan Marburg GbR, Marburg, Germany

3 Büro für Fischbiologie und Gewässerökologie, Marburg, Germany

Apart from the maintenance of genetic variability within populations, the preservation of the integrity of locally adapted gene pools is one of the major issues in population genetics. However, restocking measurements are often conducted without knowledge of the genetic structure within and between populations.

To reconstruct the phylogeography of the endangered European crayfish species *Astacus astacus*, we analysed partial sequences of two mitochondrial genes (16s rRNA, COI) from 312 specimens of 60 stocks. Specimens were samples from the main European river basins. Among the analyzed samples 9 alleles of 16s rRNA and 12 alleles of COI could be identified. Of each fragment one allele was dominant in the studied populations whereas all other alleles were less frequent. Resulting phylogeographical patterns were in accordance with the following expectations:

1. A glacial refuge in the Balkans served as source for postglacial recolonisation of central Europe.
2. A north- and westward spread after the last ice age took place along the Danube basin.
3. Due to repeated founder effects, haplotype diversity was reduced from southern to northern Europe. On a regional scale, mitochondrial haplotypes were identified from 20 stocks within one river basin (Lahn). In addition, population genetic diversity of those stocks was estimated by microsatellite analysis. Resulting genetic patterns form a knowledge basis for a conservation project in Hessen, a federal state in Germany, to identify suitable donor populations for restocking.



## Europe's Dragonflies on the Move

Anja Jaeschke<sup>1</sup>, Torsten Bittner<sup>1</sup>, Björn Reineking<sup>2</sup>, Helmut Schlumprecht<sup>3</sup>, Carl  
Beierkuhnlein<sup>1</sup>

<sup>1</sup> Biogeography, University of Bayreuth

<sup>2</sup> Biogeographical Modelling, University of Bayreuth

<sup>3</sup> Büro für ökologische Studien, Bayreuth

The potential impacts of climate change on species distributions are the topic of ongoing debate. Dragonflies are a particularly interesting species group in this context: Due to their aquatic way of life, dragonfly larvae are directly affected by changes in precipitation, temperature and other climatic factors, whereas adult dragonflies as good dispersers may be able to track the shifts of climate space. Shifts in dragonfly species composition can already be observed. Several dragonfly species are protected under the Habitats Directive of the European Union. We here focus on EU-wide protected species, as we are interested in the impacts of climate change on the Natura 2000 network in our research project (funded by the BfN). Some species, such as the West-Mediterranean *Oxygastra curtisii*, show already an active spread into new areas, for example into Germany. Consequently, the responsibility of countries with respect to species protection is changing with the shift in species distributions. We identified several EU-wide protected dragonfly species that are, either currently or potentially in the future, relevant for nature conservation in Germany. We projected the potential future occurrence probability of these selected species based on climatic variables, dispersal abilities and land cover information, using Boosted Regression Trees as modelling algorithm. The potential range changes of these species, the driving factors, and the implications for nature conservation are discussed.



## **Variation of biomass quality in chalk grasslands – Consequences for conservation management**

*Till Kleinebecker*<sup>1</sup>, Heidi Weber<sup>1</sup>, Norbert Hölzel<sup>1</sup>

<sup>1</sup> Institute of Landscape Ecology, University of Münster

Low-intensive grazing is a widely-used management tool to conserve and restore the outstanding biodiversity of chalk grasslands. Conservation management is cost-intensive and thus often hampered by limited financial resources. Balancing necessities of nature conservation and requirements of livestock-keeping farmers is promising for sustainable and long-term conservation management. We analyzed floristic composition, soil chemical characteristics and chemical composition of aboveground biomass in a grazed chalk grassland in NW Germany. Sampling took place in monthly intervals. To separate the impact of grazing, an enclosure experiment was performed. Floristic composition was mainly affected by two gradients representing the trophic status and the long-term management intensity. Differences in abiotic site conditions were hardly reflected by the nutritional value of the biomass. Irrespectively of the abiotic site conditions, the chemical composition of the biomass showed a clear seasonal trend. Nutrient concentrations strongly declined from May to July but increased again in August, probably due to favourable current-year weather conditions. Grazing had a positive impact on the nutritional value of the biomass indicating that sheep grazing modifies the environment beneficially for the animals. We conclude that an early spring and a late summer grazing is an appropriate management scheme to combine both requirements of feasible livestock production and biodiversity conservation.



### **Cessation of traditional land-use and its effect on biodiversity in a sandy desert in Israel**

*Ittai Renan*<sup>1</sup>, Pua Bar (Kutiel)<sup>2</sup>, Eli Groner<sup>3</sup>, Amnon Freidberg<sup>1</sup>

<sup>1</sup> Department of Zoology, Tel Aviv University

<sup>2</sup> Department of Geography and Environmental Development, Ben-Gurion University of the Negev

<sup>3</sup> Mitrani Department of Desert Ecology, The Jacob Blaustein Institutes for Desert Research, Ben-Gurion University of the Negev

Habitat loss is one of the world's main factors for reducing biodiversity. However, habitat loss may also result from human inactivity. Ceasing a traditional age-old activity may lead to dramatic changes in landscape condition and loss of local fauna and flora. The north-west Negev sand dunes, characterized by a great number of endemic species, constitute the largest sandy area in Israel. For thousands of years the natural process of dune stabilization was prevented by the grazing and trampling of nomadic Bedouin herds. The lack of such traditional activity in recent decades has conducted to the rapid formation of firm biogenic crusts, stabilizing the dunes. Our research aimed to examine the impact of this sand stabilization on the ground-dwelling arthropod community. During spring 2008 and 2009, using pitfall traps, we sampled the two extremes of landscape: crests of shifting dunes and crusted inter-dune depressions. The findings indicate that different landscape units are characterized by different arthropod communities. The shifting dune crests host mainly psammophilic species that exist almost exclusively in this habitat; while the inter-dune is mainly characterized by species that are typical to the Negev's loess plains. Active management is required in order to prevent a complete loss of the shifting sand habitat and its endemic species. Initial dune restoration research is taking place with the collaboration of the Israel Nature and Parks Authority.



## **Sustainable resource use – An approach to combine bioenergy, climate and nature protection**

*Christian Hildmann*<sup>1</sup>

<sup>1</sup> FG Raum- und Umweltplanung, Martin-Luther Universität Halle-Wittenberg

Intensive agricultural land use often seems to be contrary to the protection of nature and landscape. The production of biomass and renewable resources intensify this conflict, demonstrated by the expanded production of rape and maize. The competition for land for the production of food, biomass, renewable resource or for nature protection increases already today in Central Europe. Nevertheless, biomass is storable energy and therefore a valuable contribution to the energy mix in future. A first analysis of two different regions in Germany had been undertaken: The former district Havelberg (Saxony-Anhalt), which is mainly part of the biosphere reserve Mittelelbe, and the resource region of the city Hoyerswerda (Saxony). Both case studies show an unforeseen amount of not used and waste biomass, which is available from the maintenance of the roadsides, the running waters and landscape preservation. Furthermore there is much more grassland than currently used for keeping cattle. With this resources outside of land competition and an adapted logistic the heat supply of a large amount of households is possible. This biomass potential could even be increased. Developing a buyers structure and adapted technology offers a great opportunity for a multifunctional framework of new landscape elements, especially for the cleared out landscapes. Biomass production could be combined with water retention, support of local climate, connecting biotopes and enrichment of the natural scenery.



POSTER PRESENTATIONS:

**Innovative waste management for open-air festivals: Minimizing environmental damage caused by crowds in semi-natural landscapes**

Arne Cierjacks<sup>1</sup>, Friederike Behr<sup>2</sup>, Ingo Kowarik<sup>1</sup>

<sup>1</sup> Department of Ecology, Ecosystem Science / Plant Ecology, Technische Universität Berlin

<sup>2</sup> Ecocontrolling GbR, Berlin, Germany

Major open-air festivals have become a common phenomenon in many countries. The environmental consequences of crowds in semi-natural areas such as waste littering or damage of vegetation have increasingly been recognized by event managers. However, a scientific basis for ecologic waste and crowd planning is still lacking. To understand waste and crowd distribution and its effects on vegetation, we analyzed waste littering, crowd density and vegetation cover at three German open-air festivals and tested differences among event zones and the impact of waste-reducing activities. Waste littering reached values up to  $3.5 \text{ t h}^{-1} \text{ ha}^{-1}$ . High crowd densities led to a significant decrease in vegetation cover affecting also protected habitats. Stage, way, food, and sanitation zones showed significantly higher littering than entrance zones. Fencing, bin location, and waste regulation on camping zones proved to decrease overall littering. Moreover, dishes deposit and visitor information showed a significant effect on the littering of residual waste. Vegetation clearly profited from fencing, but this was only applicable in zones with low crowd density. We conclude that well-directed fencing and bin location along with clear waste regulations are the most efficient measures to reduce waste littering and vegetation damage at festivals. Overall, the findings of our study imply several specific measures for waste-intensive festival zones which can improve waste management at major festivals.



## **The influence of genotype of donor plants on the induction of embryogenesis of DH-lines of Brassicas**

*Mykola Klymchuk*<sup>1</sup>

<sup>1</sup> Department of Ecology, Ivano-Frankivsk National Technical University of Oil and Gas

The biotechnology technique, particularly the method of isolated microspores, can be very useful for multiplications of small quantity of plants of rural and endemic species of *Brassicac*s for saving biodiversity. Besides genus of *Brassicac*s in many cases is used as essential genomic model for investigations in inter -species and -genus crossing as well. But in practical using numerous factors influencing on embryogenesis of isolated microspores should be evaluated and optimized depending from species. This includes nutrient mediums, growth condition of donor plants, genotype and microspore developmental stage. Therefore, influence of genotype of donor plants on the induction of embryogenesis of isolated microspores and later on growing up DH-lines of mature plants of *Brassica napus*, *Brassica campestris* and *Brassica oleracea* was investigated. It was showed remarkable contrast for different genotypes of *Brassicac*s. It was established that cultivation of donor plants in controlled environmentally condition is a very important aspect for efficient yielding of embriogenic buds. The highest yield of microspore embryos was obtained when microspore were isolated in the late uninucleate stage and when the incubation of microspores was for at least 9 days at 32°C that leads to stable embriogenic development. Isolated microspores culture has been shown to be one of the most useful systems for plant regeneration *in vitro*.



**Factors influencing early grassland succession in the Eifel National Park: Wild boar (*Sus scrofa*), field paths, former land-use and neighbourhood relationships**

Klara Krämer<sup>1</sup>, Silvana Siehoff<sup>1</sup>, Gottfried Lennartz<sup>2</sup>, Martina Roß-Nickoll<sup>1</sup>

<sup>1</sup> Institute for Environmental Research (Biology V), RWTH Aachen

<sup>2</sup> Research Institute for Ecosystem Analysis and Assessment (gaiac), RWTH Aachen

In 2004, the Eifel National Park was founded to protect beech forests and open grassland. In the core zone, utilisation is being ceased. A grassland succession model (GraS-model) was developed to support decision making processes regarding perspectives and aims for the grassland areas. The GraS-model simulates the changes of the vegetation over time, starting with a biotope type mapping of 2005. To provide data for the model, the influences of different factors on grassland succession were observed in 2008 by counting individuals of succession-relevant plant species at selected sites:

**Wild Boar:** Wild boars caused damage to the cover vegetation. In lack of a grass layer, the establishment of succession-relevant species was facilitated.

**Field paths:** Old field paths were characterised by soil compaction which suppressed the development of a grass layer. Despite of the soil compaction, the establishment of succession-relevant species was facilitated.

**Former land-use:** The grassland areas contain both former hay meadows and pasture land. The observed former hayfields tended towards succeeding to a pre-forest whereas the former pasture land developed to fallow land dominated by *Cirsium arvense*.

**Neighbourhood relationship:** Seed dispersal is limited by range. The neighbourhood produced the seeds, which thereafter germinated in the grassland. Therefore, the neighbourhood relationships were important for early grassland succession.



## **Biodiversity Scenarios for the 21st Century**

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<sup>1</sup> DIVERSITAS

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DIVERSITAS, in partnership with the UNEP/WCMC, was contracted to prepare a synthesis of scenarios of biodiversity change over the 21<sup>st</sup> century for the Convention on Biological Diversity (CBD). The main messages of the scenarios were incorporated into the Global Biodiversity Outlook 3 (GBO3) report, the detailed analyses of the scenarios were published as a CBD technical report no 50, “Biodiversity Scenarios: Projections of 21st century change in biodiversity and associated ecosystem services”. The scenario synthesis involved more than 40 leading scientists and focused on 21<sup>st</sup> century biodiversity change as predicted by models based on experiments and observed trends. The synthesis paid particular attention to interactions between biodiversity and ecosystem services, as well as critical “tipping points”, that might lead to potentially irreversible changes in an ecosystem. Based on the model projections, global change impacts will result in significant changes in distribution and abundance of species, assemblages and biomes, leading to considerable ecosystem modifications. In certain ecosystems (e.g. the Amazonian forest or Arctic Tundra), irreversible conversion is ecosystems is likely. These “tipping points” are caused by complex feedback mechanisms that are not as yet fully understood, but are linked to large negative regional and global change impacts. The results of the study thus call for a precautionary approach to future human activities.



## Recultivation and sustainable biofuel production in former mining areas?

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The increasing demand for alternative energy resources leads to land use conflicts between biofuel production versus food production. We therefore suggest semi-natural and species-rich plant communities on former mining sites to be an alternative for sustainable biofuel production, since the virgin, nutrient-poor lithospheric substrates are not suitable for agriculture without expensive precultivation. Here we present the outline of a project investigating experimentally the feasibility and prospects of herbaceous biomass production combined with reclamation practices in former mining areas. The aim of this study is to evaluate methods that allow for high biomass yields in combination with ecological sustainability through the establishment of stable and species-rich plant and soil communities. In contrast to conventional reclamation techniques, we will apply an alternative method using low-input techniques: seeding wild plant mixtures of varying functional group composition combined with inoculation with arbuscular mycorrhizal fungi and nitrogen fixing bacteria. Our experiment will be conducted on multiple sites in a former lignite mining area in central Germany, and will be performed in a split-plot design to prevent cross contamination of the inoculants. In the subplots, plant species and functional diversity will be varied to explore their importance for sustainable biomass production. Thereby, we intend to put results from previous biodiversity experiments into practice.



## The effect of branch length estimates on measures of phylogenetic diversity

*Stefan Michalski*<sup>1</sup>, Ingolf Kühn<sup>1</sup>, Oliver Schweiger<sup>1</sup>

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Measures of phylogenetic diversity critically depend on the estimate of evolutionary distance among taxa within a given phylogenetic hypothesis. However, for large assemblages of taxa often only information about the topology of the phylogenetic tree is available while branch lengths are missing. Here, we evaluate the performance of two indices of phylogenetic diversity based on two different branch length estimates that require no a priori information about evolutionary divergence, compared to empirically derived branch lengths on a given topology. We found that phylogenetic diversity indices calculated with branch lengths estimates based on topology following Grafen (1989) represented a reasonable surrogate and performed better than when branch lengths were set to unity. However, a restricted ability to reflect the ‘true’ difference in phylogenetic diversity among communities demands caution, especially when using phylogenetic diversity for conservation purposes. The additional effort to obtain empirical estimates for the amount of evolutionary divergence among taxa might thus be seriously considered.



## Monitoring high nature value grassland in Transylvania, Romania

*Laura Sutcliffe*<sup>1</sup>, Krystyna Larkham<sup>2</sup>

<sup>1</sup> Albrecht-von-Haller Institute of Plant Sciences, Georg-August University of Göttingen

<sup>2</sup> Imperial College London

Semi-natural grassland has in recent decades become increasingly rare in much of Europe, however, low levels of intensification and small-scale farming have led to the preservation of substantial areas of this valuable habitat in Romania. Nevertheless, here too land management practices have in recent years begun to change, and there is increasing threat to Romanian grassland biodiversity from abandonment and intensification. One means of countering this threat is to offer financial support for non-ecologically damaging farming through agri-environment scheme payments, such as the scheme initiated in Romania for High Nature Value grassland in 2007. One important aspect of agri-environment schemes is the monitoring of its efficacy in maintaining or improving the ecological quality of the farmland. Therefore, this investigation uses multivariate analysis of vegetation survey data to identify a list of plant indicator species that can be used to monitor the quality of lowland grassland under agri-environment scheme, based on the study region of Southern Transylvania.



### **Proposal for the creation of a new Natura 2000 site in the Csík Mountains (Munții Ciucului), Eastern Carpathians, Romania**

Anna-Mária Csergő<sup>1</sup>, László Demeter<sup>2</sup>, Zsolt Molnár<sup>3</sup>, Gusztáv Jakab<sup>4</sup>

<sup>1</sup> Sapientia University, Marosvásárhely, Romania

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<sup>4</sup> Szent István University, Szarvas, Hungary

Based on the available literature data and on surveys during 2009, we have completed the SCI proposal of the Csík Mountains. The proposed site has an area of approximately 1400 km<sup>2</sup>. So far, we have identified 17 types of Natura 2000 habitats, of which *Nardus* grasslands and mountain hay meadows are outstanding from the point of view of plant species richness and number of protected species. A quadrat of 4x4 m on the Western part of the Gyimes pass contained more than 80 vascular plant species, which is one of the most species rich plant communities at this scale in Europe. Among the species listed in the Annex II of Habitat Directive, four are present in this area: *Ligularia sibirica*, *Pulsatilla patens*, *Cypripedium calceolus*, *Tozzia carpathica*. We identified a large number of nationally protected, endemic or glacial relic plant species (altogether 56 taxa), and the list will probably increase. We identified 32 animal species listed on Annex I of the Birds Directive and Annex 2 of the Habitats Directive, of which three are large carnivores, three are amphibians and 22 birds. We estimate that the proposed site is the largest mountain hay meadow area of the Eastern Carpathians. It is also important to note that hay meadows are part of a living rural landscape, where rural communities continue traditional semi-subsistence farming...



## **SESSION 25 – BASICS AND TOOLS FOR EFFECTIVE CONSERVATION IN MAMMALS**

### **GRUNDLAGEN UND INSTRUMENTE FÜR EFFEKTIVEN ARTENSCHUTZ BEI SÄUGETIEREN (GERMAN SESSION)**

CONVENOR: JORGE ENCARNÇÃO, UWE KIERDORF

#### ORAL PRESENTATIONS:

**Effects of contaminant exposure on mammal populations – Large mammals and fluoride**

**Einfluss von Schadstoffbelastungen auf Säugetierpopulationen – Fluorid und Großsäuger**

*Uwe Kierdorf<sup>1</sup>*

<sup>1</sup> Department of Biology, University of Hildesheim

Results of studies on fluoride exposure of free-ranging European (deer, wild boar) and Australian (kangaroos) mammals and the effects of excess fluoride intake on these animals are presented. Due to the physicochemical properties of the fluoride anion, fluoride retention occurs almost entirely in the mineralized tissues of the mammalian body. Bone fluoride concentration can therefore serve as a biological indicator of lifetime fluoride exposure. In deer, the annually replaced antlers have been used as a monitoring tool for a standardized assessment of the animals' fluoride intake. Analysis of larger time series of antlers allows a historical monitoring of variation in fluoride exposure and thereby a reconstruction of temporal changes in atmospheric fluoride deposition over longer periods of time. Occurrence of a fluoride-induced dental pathology, known as dental fluorosis, enables a rapid and cost-effective survey of fluoride loads in wildlife habitats. Using the biomarker dental fluorosis in deer, especially *Capreolus capreolus*, as a specific indicator, large-scale studies of fluoride pollution have been and are currently being conducted in different European countries.



## Monitoring of large mammals with a combination of aerial infrared and high resolution RGB images in forested areas – A status report

### Monitoring von Großsäugern in Waldlandschaften mittels Luftbildern

*Ulrich Franke*<sup>1</sup>, Bianca Goll<sup>1</sup>, Felix Wilmes<sup>2</sup>, Ulf Hohmann<sup>3</sup>, Anja Stache<sup>4</sup>, Marco Heurich<sup>4</sup>, Niels Hahn<sup>5</sup>

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<sup>3</sup> Research Institute for Forest Ecology and Forestry, Division Forest and Wildlife Ecology, Trippstadt, Germany,

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The use of cost effective and silent light aircrafts and the increased availability of infrared cameras on the civil market made the aerial surveys with IR cameras an interesting option. We want to present our results of aerial counts of larger mammals in forested areas using a combination of IR and RGB true colour images. The IR images are being used for detection whereas the high resolution RGB images are being used for species-specific identification. The aircraft was equipped with a computer linked camera system consisting of a JENOPTIC® infrared camera (640\*480 Pixel) and a Canon 5D Mark 2® high resolution RGB camera. The aim of the 3 year project (Oct. 2008 – Sept. 2011) which is sponsored by the Deutsche Bundesstiftung Umwelt (DBU) is to establish a new monitoring method for larger mammals (especially ungulates) in forested areas. Until April 2010 we flew 21 missions over the national parks Bayerischer Wald, Hainich, Kellerwald-Edersee and the biosphere reserve Pfälzer Wald-Vosges du Nord. We overflew each investigation area of about 6000 ha in linear transects. Flying in altitudes of approximately 450 m above ground level the cameras scanned an area of 1.200-2.000 ha per flight, thus covering 20-30% of the investigation area. Depending on the area up to 19 larger mammals per 100 ha were detected. Furthermore we accomplished a study to test the detection rate in relation to the coverage (different type and density of the vegetation). Further flights are being planned for 2010/2011.



## **Bats and small mammals as model species of ecological research**

### **Fledermäuse und Kleinsäuger als Modellarten ökologischer Forschung**

*Jorge A. Encarnação*<sup>1</sup>

<sup>1</sup> Mammalian Ecology Group - Department of Animal Ecology, Justus-Liebig-University of Giessen

Bats and small mammals play a key role in many ecosystems and are important indicator organisms for an ecosystem-based conservation. Both groups, however, show clear differences in their life history strategies. Bats are distinguished by their longevity, the small number of offspring and their slow physical development (K-strategists) in contrast to other insectivorous small mammals (r-strategists). Through their active flight, night activity and echolocation bats can capture nocturnal flying insects. Thus they occupy a trophic niche, which they can, in contrast to the mainly ground living insectivorous small mammals use almost unrivalled. In order to answer fundamental questions about the ecology and protection of small mammals and bats, and to analyze the situation and the threat to indigenous species and their habitats, we need next to studies of habitat use and behaviour also studies in the field of reproduction, nutrition and ecophysiology. The usefulness of these current research findings for effective conservation programs in landscape and action planning is presented.



**Feeding ecology and conservation of the Pond bat (*Myotis dasycneme*)****Nahrungsökologie und Schutz der Teichfledermaus (*Myotis dasycneme*)***Frauke Krüger*<sup>1</sup><sup>1</sup> Ecology Centre, Institute of Nature and Resource Conservation, Christian-Albrechts-University, Kiel

In northern Europe the Pond bat *Myotis dasycneme* (Boie, 1825) is the largest trawling *Myotis* and one of the most threatened bats in Germany. This study is focussing on the diet of *Myotis dasycneme* in comparison to the sympatric Daubenton's bat, *Myotis daubentonii* and putative competition. Secondly we are interested in the relationship of food habits of *M. dasycneme* to time and place of foraging and to behaviour patterns of both bats and insects. Both *M. dasycneme* and *M. daubentonii* feed mainly on Chironomidae (*M. dasycneme*: 44,4%; *M. daubentonii*: 32,8%) and Trichoptera (*M. dasycneme*: 20,4%; *M. daubentonii*: 22,2%), which is also indicated by Pianka's index, based on similar prey composition and preferences, estimated with 0,97. Nevertheless, there are differences in the diet of both species (Adonis:  $F = 2.69$ ,  $P = 0.026^*$ ), also shown through reciprocal Simpson index and NMDS. From the results of this study it can be concluded that although *M. dasycneme* shows certain parallels with *M. daubentonii*, they do differ in the amount of single prey groups. Thus this study shows no evidence for high resource competition for prey between *M. dasycneme* and *M. daubentonii*. A different distribution of both species in time and space within the hunting habitats as well as preference of different hunting techniques (aerial hawking vs. trawling) is a possible coexistence scenario. Our data verify the importance of protecting natural and functional water systems as hunting areas.



**Relevance of movement ecology and energetics for bat conservation****Bedeutung energetischer Grundlagen für den Fledermausschutz**

*Nina I. Becker<sup>1</sup>, Jorge A. Encarnaçãõ<sup>2</sup>, Marco Tschapka<sup>1</sup>, Elisabeth K. V. Kalko<sup>1</sup>*

<sup>1</sup> Ulm University

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Considering the energy-expensive lifestyle of bats and the high demands during reproduction, changes of previously heterogeneous landscapes into monocultures and the concomitant decline in prey quality and availability are likely to contribute strongly to the observed population decline of many bat species. High quality habitats with sufficiently high food availability are essential for maintaining stable populations. In order to develop meaningful protection strategies it is necessary to understand the energetic demands of bats in relation to habitat characteristics, in particular the question whether the animals can obtain enough energy during energy-demanding times such as reproduction. Previous studies focused mostly on single aspects such as presence, home range size or food spectrum of individual bat species. We argue that this information needs to be augmented by a thorough knowledge of the energetic demands of bats throughout the year, by data on availability and access of energy (i.e., food) to the bats in the respective habitats and by a comparison of several species with similar ecologies. We are convinced that meaningful conservation plans and management strategies can only be implemented successfully with a thorough understanding of the characteristics and dynamics of the “energy landscape” in relation to the respective consumer, here bats.



## **Current state of conservation data storage in Hesse**

### **Stand der Naturschutzdatenhaltung in Hessen**

*Bernd Rüblinger<sup>1</sup>*

<sup>1</sup> Hessisches Ministerium für Umwelt, Energie, Landwirtschaft und Verbraucherschutz

The current state of conservation data storage in Hesse is presented: what sorts of data are available, how are they extracted and processed, practical examples (mammalian data), which possibilities of cooperation and exchange of information between conservation agencies, academia and voluntary work are possible?



**Habitat distribution models as instruments for effective conservation efforts****Habitatmodelle als Instrumente für effektiven Artenschutz**

*Tobias Erik Reiners*<sup>1</sup>, Jorge A. Encarnação<sup>1</sup>

<sup>1</sup> Mammalian Ecology Group, Justus-Liebig-University Giessen

Habitat distribution models (HDMs) enjoy increasing popularity due to major advantages in methodology and applicability. With the aid of these developments HDMs allow to reasonably forecast anthropogenic effects on patterns of species distribution at different spatial and temporal scales. Nowadays HDMs find wide application in conservation planning and for the assessment conservation management issues. Spatially explicit HDMs help to plan large scale conservation programs and play an important role when designing reserve networks that protect biodiversity. Spatial explicit HDMs allow for identifying suitable landscape features and minimum-dispersal corridors for species migration across reserve networks under future land use change or climate change scenarios. This is especially important when evaluation large scale conservation programs like the NATURA 2000 directive. Recent applications of HDMs also incorporate effects of species migration, population dynamics and biotic interactions make HDMs even more suitable for highly mobile or rare species. This is especially important when modeling distribution of endangered species on the Fauna-Flora-Habitat Directive suffering mainly from loss of habitats and fragmentation of landscape. Here we give an overview on the range of applications of HDMs and how these can support conservation efforts for large carnivores, highly mobile bats as well as small sized rodents.



## The situation of beavers (*Castor fiber albicus*) in Germany

### Zur Situation des Elbebibers (*Castor fiber albicus*) in Deutschland

Dietrich Heidecke<sup>1</sup>, Annett Schumacher<sup>2</sup>, Jens Teubner<sup>3</sup>, Jana Teubner<sup>3</sup>

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<sup>3</sup> Naturschutzstation Zippelsförde

The autochthonous subspecies *Castor fiber albicus* is an example for successful species conservation and long-term monitoring among mammals. In 1890 only a small relict population existed in the middle reaches of the Elbe river: 90 colonies with 200–300 beavers. Only since 1970 population has developed persistently progressive. Today *Castor f. albicus* colonizes a complete area from the Baltic Sea to the low mountain ranges in southeastern Germany and the northern part of the Czech Republic. Furthermore subpopulations based on reintroduction projects can be found in different parts of Germany as well as in Denmark and in the Netherlands. Meanwhile 43% of the present population are based on reintroduction projects. Contact zones to East-European beaver populations exist in the Oder-Neisse region and in the upper reaches of the Elbe river. A mixed population is emerging here. Allochthonous beaver-forms also migrate into Hesse, Thuringia and Saxony as well as into the range of the Dutch subpopulation. Therefore genetic resources of *Castor f. albicus* seem to be threatened by migration of allochthonous forms in the long term. The whole population of *Castor f. albicus* amounts to 8500 beavers, in Germany to 8000 beavers. Information will be given on population, abundance, and growth rate of *Castor f. albicus* in Germany. The population of *Castor f. albicus* is saved, but still threatened. Based on population data management measures are discussed.



## Beaver in the Southwest of Germany

### Biber in Südwestdeutschland

*Rainer Allgöwer*<sup>1</sup>

<sup>1</sup>Büro für Ökosystemforschung

The beaver was exterminated by hunting in Baden-Württemberg in the first half of the 19th century. After 150 years, first beavers immigrated from Alsace and from Switzerland to Baden-Württemberg again. Meanwhile the courses of the large rivers were significantly changed; the country was divided of settlements and cut through strongly frequented traffic routes. Six generations of Baden Württemberg's inhabitants grew up without the knowledge concerning the beaver. Mostly people had a different perception of the characteristics of a beaver habitat then the beavers themselves. Consequently, conflicts were pre-programmed. In order to enable a widely conflict-free coexistence between humans and beavers, the return of Europe's largest rodent needs to be managed. Since beavers shape their biospheres by themselves, it is necessary to create the appropriate space for example through buffer strips of at least 10m or the creation of additional water areas. Human settlement areas at the water are protected by technical measures. Thereby the beavers proved to be adaptable to drive away. Due to numerous intraspecific regulative, hunting of the beavers is as little required as the selection of specific animals. Furthermore each conflict requires an individual approach for resolution, whereat attention should be paid to the legal equalisation of nature conservation and human interests. Conflict management must be accompanied by extensive public relation, since beavers are aimed to become a part of the local fauna again.



## **Large carnivores in Germany – Challenges for Nature Conservation**

### **Große Karnivoren in Deutschland – Herausforderungen an den Naturschutz**

*A. Kruess*<sup>1</sup>

<sup>1</sup> Bundesamt für Naturschutz, Abteilung für Ökologie und Schutz von Fauna und Flora, Bonn

In Germany, the recolonization of large carnivorous species by dispersal from eastern and southern neighbour countries or within the national territory has been observed over the past years.

Hence, Germany has to meet the challenge of increasing conservation and management requirements for wolf, lynx and brown bear.

To meet these challenges intensive research is necessary focussing on the spatio-temporal dispersal of the species, their home ranges, habitat selection and nutritional characteristics. Moreover, solutions for human-carnivore conflicts, and adequate techniques to monitor individuals and populations need to be developed.

For the re-establishment and long-term-survival of these predators, the coordination and harmonisation of management activities on both European and national level are of particular importance.

A crucial point is to address the human dimension: we have to find pragmatic ways to coexist with these species - species which unfortunately can often prove to be rather difficult neighbours.

The application of both scientific knowledge and traditional experience should be used to overcome or minimize conflicts. In addition, public awareness campaigns may alter the low acceptability towards the species.

The Federal Agency for Nature Conservation is focussing on these topics since several years and has initiated several research projects. First results have been already published.



## **A safety-net for the wildcat**

### **Ein Rettungsnetz für die Wildkatze**

*Thomas Norgall*<sup>1</sup>, Jörg Nitsch<sup>1</sup>, Thomas Mölich<sup>2</sup>, Burkhard Vogel<sup>2</sup>

<sup>1</sup> BUND Hessen

<sup>2</sup> BUND Thüringen

Several years ago the need to establish habitat connectivity found entrance to the legislation of the federal and state governments. With the campaign "A safety net for the Wild Cat" the still insufficient implementation is to be supported and the special problems of transport infrastructure construction are to be mitigated for mobile species. The wild cat is used as indicator species for the species of the ecosystem "forest". The campaign is based on extensive public relations, inventory investigations, genetic analysis, planning derivation of possible connectivity corridors and the practical implementation of these plans. BUND cooperates i.e. with research institutions, government agencies and voluntary conservation organisations. The campaign would not be possible without the financial aid of the German Federal Environmental Foundation (DBU), the Frankfurt Zoological Society (FZS) and the LIFE + - Funding of the EU Commission.



**Wild cats - Research past and present****Wildkatzen – Forschung in Vergangenheit und Gegenwart***Clara Stefen*<sup>1</sup><sup>1</sup> Museum für Tierkunde, Senckenberg Naturhistorische Sammlungen Dresden

The European wildcat (*Felis silvestris*) is under special protection in Europe under the European Flora-Fauna-Habitat Directive since 1992 and interest in this species increased. The diverse literature on the wild cat of the last more than 200 years has been analysed in relation to several ecological parameters, like habitat, habitat requisites, food and distribution. The distinction from the domestic cat is probably the issue that has been discussed most, e. g. already Schreber 1777 gave a fairly precise description and pointed to the main differences in outer morphology. Also the possibility of hybridization between both has been recognized early. Wild cats occurred from Scotland to the Mediterranean and from Portugal to the Black Sea and different habitats had to be used. Woodlands play a major role, different kinds are used like birch-, mixed deciduous and coniferous forest, Mediterranean types of hardwood forests and alluvial forests. Probably even more important are food availability and borders between habitat types so that in some recent literature mosaic landscapes are stressed. Wild cats have been hunted to near extinction mainly in the 18th and 19th century and in Germany they survived only in few refuge areas. Since the Second World War the distribution range has markedly expanded as is shown in superimposing published maps and by the increase of proofs of wild cats using lure sticks and molecular techniques.



## **The Eurasian lynx in the Greater Bohemian Forest Ecosystem – Management implications based on space use and prey distribution**

### **Der eurasische Luchs im Ökosystem Bayrischer Wald – Schlußfolgerungen zum Management auf Grundlage von Raumnutzung und Beuteverbreitung**

Anja Stache<sup>1</sup>, Tom Brand<sup>2</sup>, Manon Kaandorp<sup>2</sup>, Sabine Müller<sup>2</sup>, Marco Heurich<sup>1</sup>

<sup>1</sup> Department of Research and Documentation, Bavarian Forest National Park

<sup>2</sup> University of Applied Sciences Van Hall Larenstein, Leeuwarden, Netherlands

The Šumava and Bavarian Forest National Parks form the largest strictly protected area (ca. 930 km<sup>2</sup>) in Western Europe. Embedded in the Bavarian Forest Nature Park (3070 km<sup>2</sup>) and the Šumava Landscape Conservation Area (1000 km<sup>2</sup>), the entire complex is referred to as the “Greater Bohemian Forest Ecosystem”. After the reintroduction in the early 1980ies, Eurasian lynx (*Lynx lynx*) now occurs in the whole area. In 2006 a transboundary research project has been started to analyse lynx ecology. Camera trapping and snow tracking in the parks proved that they are continuously used by several lynxes. In addition, the GPS-telemetry revealed that all lynxes caught in the park frequently used the surrounding areas. One of the most important factors for habitat suitability and home range size is food availability. Therefore, in both National Parks and their surrounding areas (3500 km<sup>2</sup>) pellet group counts of red deer, roe deer, wild boar and hare were done to evaluate the prey distribution. The prey density was low inside both National Parks and increased in the surrounding area especially in Czech Republic. As a consequence the National Park administrations should evaluate their wildlife management with the aim to improve the habitat suitability for Eurasian lynx.



**Evaluation of two successive camera-trapping sessions of Eurasian lynx (*Lynx lynx*) using digital cameras to reveal survival, population trends and abundance estimates****Evaluierung zweier sukzessiver Fotofallenmonitorings des Europäischen Luchses (*Lynx lynx*) zur Aufdeckung von Überleben, Populationstrends und Abundanzschätzungen**

Kirsten Weingarth<sup>1</sup>, Luděk Bufka<sup>2</sup>, Felix Knauer<sup>3</sup>, Marco Heurich<sup>1</sup>

<sup>1</sup> Department for Research and Documentation, Bavarian Forest National Park

<sup>2</sup> Šumava National Park

<sup>3</sup> Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna

In winter 2008/2009 we evaluated the use of digital photography in capture-mark-resight (CMR) techniques for estimating lynx population abundance and density. We installed two opposing cameras on 24 sites based on a systematic grid of 2.7 km in the Bavarian Forest National Park (BFNP). Within 2400 trap nights, until March 2009 we captured five adult and three juvenile lynx. Further data analysis was carried out by using the program MARK. We estimated density with camera trapping data using the MMDM from 0.6 to 0.8 Individuals per 100 km<sup>2</sup>. In winter 2009/2010 we repeated the monitoring on 53 sites, on over 700 km<sup>2</sup> including the adjacent Šumava National Park. From November 2009 until March 2010 we installed cameras on used lynx paths. Within 3992 trap nights we took pictures of twelve adult lynx, four subadults and eight juveniles. Due to the large scale monitoring we were able to document unregistered individuals, dispersal movements and reproduction. In order to gather additional data without the influence of mating season we carry on with the monitoring in the BFNP until August 2010. Our goal is to optimise data analysis of population models regarding individual and seasonal capture probabilities and changes due to specific behaviour. We conclude that photographic CMR sampling is a powerful tool for monitoring survival, population dynamics and trends. The data gathered in a greater spatial extend ensures higher statistical power regarding the accuracy of abundance estimates.



## **The raccoon (*Procyon lotor* L., 1758) – An invasive species in Germany?**

### **Der Waschbär (*Procyon lotor* L., 1758) – Eine invasive Art in Deutschland?**

*Irina Muschik*<sup>1</sup>, Berit Köhnemann<sup>1</sup>, Frank-Uwe Michler<sup>2</sup>

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The raccoon became an integral part of the German fauna and is designated as a „native species“ after the BNatSchG. If he is however an invasive animal remains unclear hitherto. In accordance with the Biodiversity Convention of Rio animals are stated as invasive, if they cause economic, health or ecological threats within their new habitat.

**Economy:** Raccoons could cause local crop losses while foraging, but the overall agricultural damage is negligible. In urban habitats they can sometimes cause costly damages to real estate.

**Epidemiology:** Raccoons rarely appear as carrier animals. The only known zoonosis is Baylisascariosis with four documented infections so far. Rabies, fox tapeworm or trichinas are irrelevant. However, the raccoon could function as a potential vector for Canine Distemper Virus.

**Ecology:** There is an ongoing discussion that raccoons could cause a negative effect on autochthone species, but proper scientific studies about that issue are lacking. Since raccoons are opportunistic foragers this could mitigate their force of predation on single native species. Also a pressure of competition on native carnivores was not proven yet.

Since an obliging definition about the size of damages caused by a neozoon is missing, a definite appraisal of the invasiveness remains difficult. Our present level of knowledge however leads to the conclusion that raccoons in Germany cannot be classified as an invasive species.



## Two for the road?

### Andenbär (*Tremarctos ornatus*) und Straßenbau in Ecuador

Sofia Eichhorn<sup>1</sup>, Frank von Walter<sup>1</sup>, Jan Barkman<sup>1</sup>

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The Andean Bear (*Tremarctos ornatus*) is the only bear species of the tropical Andes. Its wide habitat requirements along the altitudinal gradients make it an ideal umbrella species for protection. However, land use change and forest fragmentation threaten its survival. UNESCO Biosphere Reserves (BR) consist of strictly protected core areas, and successively less restrictive buffer and transition zones. One of those areas is the BR “Podocarpus–El Cóndor” in Southern Ecuador. It covers one of the most species rich areas of the tropical Andes biodiversity hotspot. Especially in the buffer zones roads are used and built anew. Apart from the immediate impact road construction might show several indirect effects. We conducted an ex-ante assessment of a proposed road building project. We used a land cover classification map and ran a multinomial logistic regression on the raster data. The following key factors were estimated (slope, altitude, cost distance to regional markets, distance to next village, distance to next path or road) correlated with current land-use types (pseudo  $R^2=0.2943$ ). If the road of ~19km length between two villages was built, 657ha of forest are predicted to be converted to pasture. This represents the habitat requirements of about two female bears. In turn, the additional pasture could provide 44 average-sized farming households, albeit generating only poverty level incomes. The substantially worsened habitat connectivity between the BR core area and the forest matrix additionally argues against accepting this trade-off.



POSTER PRESENTATIONS:**Home range dynamics of red deer (*Cervus elaphus*) at multiple scales**

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Generally, a home range is described as an area where animals meet their requirements for survival, growth and reproduction by exploiting available resources within the restrictions imposed by their physiology and environment. The concept of an animal's home range has evolved over time, as have methods for estimation the home range size and shape. With temporally resolved movement data, changes in home range size and use can be analysed at several scales. Variations in the size of home ranges in mammals have been attributed to many different factors including body size, sex and age, season availability of forage, fragmentation of the landscape, or intra- and interspecific competition. However, how and why home range size varies between individuals is not well understood, and neither is the spatio-temporal usage of the landscape. Here we use data on GPS-collared red deer (*Cervus elaphus*) in the Bavarian Forest National Park to analyse determinants of home range size at several temporal scales (weekly, biweekly, monthly and half year). In particular, we study the effect of resource availability on home range size and the extent of intraspecific variation in home range size and land cover preferences.



## Capture success and -efficiency of trawling bats

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To contribute to the understanding of food intake and ingested energy in trawling bats we study the capture success and -efficiency of *Myotis daubentonii*. We transfer free-living Daubenton's bats into a flight tent (20 m<sup>2</sup>) with an artificial pond (10 m<sup>2</sup>). The observations are designed to be able to evaluate the capture success and -efficiency of bats using the low-catch method gleaning prey from the artificial pond. To ensure that the prey stays on the water surface we use *Tenebrio molitor* (larvae) and *Musca domestica* (with crippled wings). The prey attacks are divided in a successful capture, unsuccessful and discontinued capture attempt. We expect high capture success rates of about 80-90% for Daubenton's bats under the conditions in the flight tent. Differences in foraging time and capture success may be caused by the two prey species since these differ in size and similarity to the natural prey. Furthermore, we expect different capture success rates in individuals due to differences in reproductive status, age and experiential skills. Preliminary results support our expectations since capture success rates differ for the two prey species as well as for different individuals. With *Tenebrio molitor* as prey we observed 656 prey attacks and capture success ranged from 59.3 % up to 71.7 % on the individual level (64.2 % successful). In contrast with *Musca domestica* as prey success rates of single individuals ranged from 80.9 % up to 89.5 % (505 observed attacks; 85.9 % successful).



**Basal metabolic rate of male Daubenton's bats in relation to microclimate, habitat location and group size**

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The aim of our study is to relate differences in basal metabolic rate (BMR) to differences in behaviour and habitat utilisation of male Daubenton's bats. BMR is a well-suited indicator for comparison of energy demands between individuals and species and is measured with indirect calorimetry following Kleiber (1961). We investigated the relationship of BMR in male Daubenton's bats to climate, food availability and sociality. As low environmental temperature lead to elevated O<sub>2</sub> consumption, male Daubenton's bats living in colder regions, i.e., highlands, should therefore have an elevated BMR. Preliminary results revealed that indeed males from the highlands tended to have a higher BMR than similar-sized males inhabiting lowland habitats. Investigation of four males from the highlands showed variations of BMR between 0.16 ml/min and 0.3 ml/min O<sub>2</sub> consumption while the BMR of four males from the lowlands ranged between 0.09 ml/min and 0.13 ml/min O<sub>2</sub> consumption. Our results suggest an association between habitat characteristics, namely temperature and BMR. Furthermore, we tested whether males living in habitats with low food availability have evolved other strategies in addition to torpor for saving energy, such as lowering their BMR. Sociality is also likely to influence BMR. Clustering of bats in large groups leads to saving of energy as there are reduced costs of thermoregulation for each individual. Therefore, males roosting in larger groups might have a lower BMR than individuals roosting alone.



**Genetic diversity of common hamster populations revealed by non-invasive genetics**

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The common hamster *Cricetus cricetus* belongs to the highly endangered species in Europe. Populations of *C. cricetus* suffered from dramatic declines in the last decades, resulting in low population densities and declining genetic diversity. Since habitat loss and landscape fragmentation are considered as the major threats, we investigated how landscape structure and isolation affect genetic distances and diversity of hamster populations. Because hamsters are endangered, rare and elusive we used a self made hair-trap for non-invasive genetic sampling that uses movable parts to collect hairs. The application of strict guidelines for non-invasive genetics and enhanced PCR-techniques allowed us to analyze 97 individuals for 10 microsatellite markers. We compared genetic diversity between three distinct local hamster populations in central Germany (N1=49; N2=24, N3=24). Results showed that despite short geographic distances (4 km and 50 km) hamster populations were genetically highly isolated ( $F_{ST}=0.23$ ). Detected genetic diversity differed significantly ranging from moderate ( $H_e=0.58$ ) to very low diversity ( $H_e=0.36$ ). These results were consistent with landscape configuration. The population with lowest diversity was found in smallest and the population with the highest diversity was located in the largest unfragmented area. These results demonstrate that fragmentation affects genetic diversity of hamster and that future conservation is only possible when considering these effects.



**Habitat-dependent diversity and community structure of forest inhabiting dwelling bats and small mammals**

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Deciduous forests play a very important role as habitats for many bat species and small mammals. On the contrary little detail is known about how the mammalian community composition and species abundance is influenced by specific forest characteristics. These include relative prey abundance, proportion of dead wood, composition of under- and overstory vegetation, density of vegetation or stand age. In this study we investigated the influence of forest structure on diversity and community composition of mammals in 15 standardized survey plots in central Germany. To assess relative prey abundance and diversity we used pitfall, sticky, and cross window traps. For faunistic assemblage small mammals were captured with live-traps. Bats were determined by mist nets and ultrasound detectors. Microclimatic conditions were recorded by data loggers in each plot. In addition to site-specific data we analyzed landscape metrics as well as topographic and climate conditions in GIS. All variables and their contribution to species occurrence were analyzed using ordination techniques as well as regression analysis. This approach allowed us to identify site characteristics which had the highest explanatory values for observed species richness patterns. Preliminary results show that habitat characteristics influence the mammalian community and species abundances. This will help to understand species richness patterns and may also help to create predictions for larger spatial scales.



**Comparative analysis of prey attacks in Daubenton's bats (*Myotis daubentonii*) at natural foraging areas and in a flight-tent**

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Considering the fact that bats are the most threatened mammals in Europe it is important to understand their behavior in the habitats to support effective protection. Not many studies focus on the foraging strategies and the flight performance during prey capture of Daubenton's bats. This study investigated the low- and highcatch-strategies of Daubenton's bat and its flight performance before, during and after prey capture at a natural and artificial feeding site in a flight-tent. Our hypothesis was that the behavior in the flight-tent is comparable to the natural behavior. We compared the flight performance using a digital infrared video camera system. Additionally we recorded the echolocation calls of the bats with an automatic system for acoustical surveys. Next to the flight performance and echolocation calls exogenous factors (insects, climate etc.) were recorded at the natural foraging areas. We assumed that exogenous factors influence the animals during foraging so that they have to adapt their behavior. First results show that the foraging behavior does not differ between natural and artificial foraging areas whereas the echolocation was adapted to the flight in a tent. The most influential exogenous factors were the insect density and clutter effects (i.e. vegetation) on the water surface. This study aims to permit the transfer of experiments from the natural habitat to the controlled conditions of a flight-tent.



**GIS-based analysis and spatial modeling of roost-site selection by Daubenton's bats (*Myotis daubentonii*)**

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Sexual segregation by behavior and sensitivity to ecological constraints or by environmental preferences are still widely unexplored phenomena in most groups of vertebrates. A well known example of sexual segregation is found in the order of bats where female and male bats may temporally select different roost-sites. But on the contrary little is known about the specific forces causing this segregation. To identify these forces and factors, long term data on distribution of roost sites of *Myotis daubentonii* in the Marburg-Giessener-Lahntal was analyzed. As bats are highly mobile and have specific habitat preferences on multiple scales, landscape metrics as well as site specific environmental data was incorporated for this study. For statistical analyses landscape metrics as well as environmental metrics were used to formulate GLMs and BRTs. Results showed that habitat selection of females and males differ strongly. Habitat models showed that structure of the forest areas and climatic conditions are the most influential factors leading to choice of nursery roosts. With the aid of R and GIS these models were used to generate spatial explicit sex-specific habitat suitability maps. Maps showed that nursery roosts were also found more frequently in closer proximity to water bodies than male roosts. These results give a better insight in sexual segregation and will improve conservation planning due to better understanding.



**Waste not, want not – Thermoregulation in male Daubenton's bats**

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As small mammals European bats show a high energetic demand and strategies to save energy like daily torpor have evolved. Drawbacks of torpor include a reduction of spermatogenesis and mating success. Therefore, males should minimize torpor usage during periods of spermatogenetic activity and mating time while torpor phases should frequently occur during sexual inactivity. Moreover summer habitats vary in regard to climate and food supply and roosting group size can vary between 1-50 males. We hypothesize that torpor usage in male Daubenton's bats is influenced by 1) sexual activity, 2) summer habitat and 3) group size. Temperature-sensitive transmitters were used to measure skin temperature during sexual inactivity, spermatogenesis and mating time. Simultaneously, ambient temperature, group size and habitat characteristics were recorded. Preliminary results show that during sexual inactivity skin temperatures fluctuate between 16°C (torpor) and 36.5°C (active in roost). Sexually inactive individuals used torpor significantly more often than active males (30 - 37°C). Furthermore, individuals in optimal habitats (favourable climatic conditions and relatively high food supply) and larger groups showed shorter torpor phases and higher mean skin temperatures. The results of our study indicate that during summer torpor behaviour of male Daubenton's bats is influenced by sexual activity, climate, and group size and is probably adapted to optimize mating success.



**Retention times of the gastrointestinal tract of Central European bats**

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To understand energetic requirements of small insectivorous mammals it is necessary to determine the resource utilization in the natural habitat which is influenced by digestion efficiency. An essential element of this efficiency is the retention time which we studied in Central European bat species. The study was conducted with adult male bats of the species *Myotis daubentonii*, *M. nattereri*, *M. myotis*, *Plecotus auritus*, *Pipistrellus pipistrellus*, *Eptesicus serotinus*, *Nyctalus noctula*, *N. leisleri* and *Vespertilio murinus* from June to August 2010 in Hesse (Germany). To determine mean retention time bats were fed ad libitum with *Tenebrio melitor* one marked by fluorescent pigments. Individual feeding time and subsequent defecation was noted and feces were checked for the marker. To fly efficiently bats must keep their body mass to a minimum. Therefore, we hypothesize that bats will have very short retention times compared to other small ground living mammals. We also predict that prey composition influences the retention time. Bats which feed on insects with a high chitin content (*M. myotis*) should have longer retention times than bat species like *M. daubentonii* which feed on soft bodied insects. First results show a significant difference between *M. daubentonii* and *N. leisleri* probably due to the different prey composition. As expected *P. pipistrellus* and *V. murinus* do not differ significantly from *M. daubentonii*, since mass and prey composition is similar in these species.



**Three peas in a pod? Energetics of three sympatric gleaning bats**

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We compared basal metabolic rate (BMR) of three similar species (*Myotis nattereri*, *M. bechsteinii* and *Plecotus auritus*; Vespertilionidae) which occur in sympatry in Central European mixed forests. Since these species are gleaners and forage in cluttered habitats we expected similar BMRs. However, BMR in Natterer's bat was significantly lower than in the other two species. Body mass could not be the only explanation as it was the same as in *P. auritus* and significantly lower than in Bechstein's bats. Differences probably can be attributed to small but important differences in life style including foraging mode. While Natterer's bat gleanes from flight and mainly uses echolocation for prey detection the other two species also listen for prey generated sound and usually briefly land for prey attacks. Parasites can also directly or indirectly influence BMR. We observed a significant increase in BMR for *M. bechsteinii* and *M. nattereri* with increasing numbers of wing mites. Although *Plecotus auritus* harboured most mites and thus should have the highest BMR, it remained at the same level regardless of numbers of mites. Mite infestation rates and hence differences in BMR are probably also linked to differences in sociality. Bechstein's and Natterer's bats both live in fission and fusion societies that might enhance the possibilities of mites to spread evenly throughout the population while *Plecotus auritus* roosts in smaller and more stable groups which might result in higher mite loads.



## POSTER PRESENTATIONS - OPEN TOPICS

### Biogeography and genetic diversity of phyllosphere pink-pigmented facultative methylotrophic bacteria

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Phyllosphere methylotrophic bacteria are characterized by their ability to utilize C1-compounds as their sole carbon and energy source. They inhabit plant surfaces, mainly leaves, and play an important role in the methanol cycle by utilizing the methanol emitted by plants. Additionally, they can produce plant growth promoting substances like auxins. One aim of this project is to analyse the abundance and genetic diversity of phyllosphere pink-pigmented facultative methylotrophs (PPFM) in dependence of inhabited plant species, geographic location of the sampling site and land-use type. Leaf samples of *Trifolium repens* and *Cerastium holosteoides* were collected from meadows and pastures from 3 sampling sites in Germany. PPFM were cultivated on selective media. Isolates were grouped using amplified ribosomal DNA restriction analysis. Phylogenetic analyses based on 16S rRNA gene sequences of representative isolates were performed. The abundance of PPFM was significantly higher for *T. repens* than for *C. holosteoides*. Geographic location of the sampling site, land-use type and fertilisation had no significant influence on the abundance of PPFM on leaf surfaces. 16 different groups of pink-pigmented isolates were found, which were similar to *Methylobacterium* species: *M. adhaesivum*, *M. mesophilicum*, *M. organophilicum* and *M. jeotgali*. The main groups of isolates could be found on leaves of both plant species, in both sampling periods, on all sampling sites and in all land-use types.



**Characterisation of nitrogen deposition and source attribution by using N-concentrations and  $\delta^{15}\text{N}$ -signatures of epiphytic lichens (*Xanthoria parietina* and *Hypogymnia physodes*) in Germany**

Stefanie H. Boltersdorf<sup>1</sup>, Willy Werner<sup>1</sup>

<sup>1</sup>Department of Geobotany, University Trier

In regions associated with high fertilizer use, intense animal keeping, and some industrial activity, atmospheric N deposition may easily be one to two orders of magnitude higher than in rural regions with minimal agriculture and lichens may be used to monitor these deposition patterns. We tested whether the nitrogen concentrations and  $\delta^{15}\text{N}$  ratios of lichens can be used to estimate deposition rates and specified sources of these compounds.

In 2008 the epiphytic lichens *Xanthoria parietina* and *Hypogymnia physodes* were sampled from 18 sites located in Germany. Samples were collected within a radius of 2 km around field stations for deposition measurement, from trees that met the requirements for bioindication with lichens. As a result of being present and absent, lichens have the ability to reflect deposition circumstances at different sites. The sensitivity of epiphytic lichens is also shown in this study. Upon investigation, we also used the function of lichens as bioaccumulators. We found ranges between high N-concentrations in *X. parietina* under high N-deposition and lower N-concentrations in *H. physodes* in areas of pure air. As expected, the  $\delta^{15}\text{N}$  ratios are in both lichen species more negative under high ammonia deposition, where N-deposition is from agricultural origin, especially from animal husbandry. The study demonstrates the possibility to estimate the deposition of total nitrogen and of ammonium on the basis of the nitrogen concentration and  $\delta^{15}\text{N}$  ratio of epiphytic lichens.



### **A novel automatic minirhizotron system for root research**

*Maik Veste*<sup>1</sup>, Jürgen Müller<sup>2</sup>, Andreas Bolte<sup>2</sup>, Hans-Peter Schäfer<sup>3</sup>, Gerhard Kast<sup>4</sup>

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The root system – the hidden half - plays an important part in the carbon allocation and for the uptake of nutrients and water for the plants. Various techniques were developed to study root development. Soil and ingrowth cores give only estimates of standing root biomass and relative growth. The minirhizotron method, in contrast to destructive methods, permits the measurement of the fine root production, mortality and turn-over. The minirhizotron technique can be used to monitor the same root(s) over selected time intervals, which can vary from days to years. Fine root production and mortality can be estimated by combining data from minirhizotrons and soil cores. Seasonal changes in the root dynamic can be related directly to above ground production. Furthermore, minirhizotrons can provide qualitative information on root color, branching and mycorrhiza. We are presenting a new automatic minirhizotron system. Positioning of the camera and image acquisition are fully automatic and controlled by a computer. Transparent glass tubes with 135 cm length and 3 cm diameter are used for root observation in the lysimeter of the Drylab in Eberswalde. First applications of investigations of fine roots of trees will be shown.



**Seed surface structure: An easy measurable trait related to seed dispersal***Christina Hoppe*<sup>1</sup>, Oliver Tackenberg<sup>1</sup><sup>1</sup> Institute of Ecology, Evolution & Diversity, University of Frankfurt

Morphological seed traits are used in many cases to assess the type of dispersal. Appendages like hooks, awns or pappi are commonly used to classify whether a species is being dispersed by a certain dispersal type or not. Here, we are using an alternative and quantitative method to assess potentials for seed dispersal on the fur of animals (epizoochory) and for dispersal by wind (anemochory). The parameter seed surface structure describes the smoothness of a seed on a continuous scale and addresses gradual differences within one morphological category. Seed surface structure can be derived easily from digital image analysis and ranges from 0 to 1. Large values reflect a smooth surface and small values a rough and highly structured surface. Seed surface structure was used already for a small species set to predict attachment potential to animal furs as a parameter related to epizoochory. Here, we develop a new statistical model that uses seed surface structure to predict retention potential to animal furs, and falling velocity of seeds as an indicator of wind dispersal potential. Additionally, we will analyze differences within the seed surface structure for more than 1000 species of the Central European flora, differing in life form and preferred vegetation type.



**Physical-chemical properties of different biochars**

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Terra Preta research gave evidence on the positive influence of charred organic material on infertile tropical soils, ranging from increased water holding capacity and cation exchange capacity to yield increases and even to an increased soil microbial biodiversity and respiratory efficiency. Hence, facing global challenges such as land degradation, fossil energy decline, water shortage and climate change, the application of charred organic material (biochar) as soil amendment, embedded in regional matter cycles seems to provide an all-round solution. However, before giving recommendations for its use, it is crucial to study the physical and chemical properties of biochar to enable predictions of its effects in soils and to evaluate possible effects on the greenhouse gas balances after application. For this presentation, different biochars were analyzed for their BET surface, black carbon content, the amount of functional groups and polycyclic aromatic hydrocarbons, pH, ash content and elemental composition. The biochars were produced via hydrothermal carbonization, low temperature-carbonization, a rotary kiln, a Pyreg reactor or wood gasifiers. Our results showed that the production processes and feedstocks significantly impacted biochar properties. A first estimation on the suitability of the different biochars for soil amendment and carbon sequestration will be provided.



## Quantification of nitrogen transformation processes in terrestrial ecosystems

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Knowledge of individual gross N transformation rates in soil is essential to understand internal N cycling processes and their contribution to N losses from terrestrial ecosystems. This paper revisits the theoretical background to quantify process-based gross N fluxes in soil. The <sup>15</sup>N pool dilution theory developed in the 1950s' is the basis for current <sup>15</sup>N tracing methodologies. While the traditional <sup>15</sup>N pool dilution technique does not allow a separation of gross production rates into process-based pathways (e.g. mineralisation to NH<sub>4</sub><sup>+</sup> from different organic N pools in soil). However latest numerical techniques based on Bayesian data analysis are able to analyze complex N dynamics. Examples will be presented from various ecosystems. This has provided us with new insights into the processes associated with N cycling in soil which will ultimately be useful to derive mitigation and sustainable land-management strategies.



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