



Open Landscapes

Ecology,
Management and
Nature Conservation

*Program &
Abstract Book*

29th September - 3rd October 2013

Hildesheim, Germany

Local Organizing Team

Ecology and Environmental Education Group
Institute for Biology and Chemistry
University of Hildesheim
Marienburger Platz 22
31141 Hildesheim, Germany
Chair: *Jasmin Mantilla-Contreras*

Scientific Committee

Holger Buschmann, Nature and Biodiversity Conservation Union (NABU) Lower Saxony, Germany
Angus Garbutt, NERC- Centre of Ecology and Hydrology, United Kingdom
Jasmin Mantilla-Contreras, University of Hildesheim, Germany
Agnieszka Piernik, NCU Torun, Poland
Jens Schirmel, University of Koblenz-Landau, Germany
Patrick O. Waeber, ETH Zurich, Group of Forest Management and Development, Switzerland
Stefan Zerbe, Free University of Bozen-Bolzano, Italy

The Open Landscapes 2013 conference is organized in cooperation with the Society for Ecological Restoration (SER) - European Chapter, the European Dry Grassland Group, the Ecological Society of Germany, Austria and Switzerland (GfÖ) and the Nature and Biodiversity Conservation Union (NABU) Lower Saxony.

Dear friends and colleagues,

I cordially welcome you to the first international conference “Open Landscapes 2013 – Ecology, Management and Nature Conservation” in Hildesheim Germany. Hildesheim, located in the North of Germany is one of the oldest cities in Lower Saxony. It apparently became a city at the end of the 12th or early 13th century. Although Hildesheim was destroyed during World War II, the city has several cultural treasures to offer. Hildesheim is particularly known for its churches. Two of them, the Romanesque St. Mary’s Catholic cathedral and the St. Michael’s church are now part of the UNESCO World Heritage Sites. The St. Mary’s Catholic cathedral is famous for its ancient bronze doors and for the “Thousand-Year-Old-Rosetree” which is also the symbol of the city. The St. Michaels’s church is a noteworthy early Romanesque church and a unique example of Ottonian architecture. Other historical treasures, particularly from Egyptian culture, can be admired in the world-famous Roemer and Pelizaeus Museum. Hildesheim is a charming city with more than 100,000 inhabitants. Of high touristic attraction is the historic market place, which was reconstructed in 1990 and is famous for its beautiful half-timbered buildings such as the Butchers Guild Hall. In Lower Saxony, Hildesheim has made a name for itself in the theatre scene- the Theatre of Lower Saxony plays for the entire state from its home basis. You might use one of the city tours to see the attractions of Hildesheim during the conference.



The University of Hildesheim Foundation is one of the first of its kind in Germany. The range of subjects covers study courses in Educational Science and the Social Sciences; Arts and Cultural Studies; Linguistics and Information Science; Mathematics; the Natural Sciences and Economics and Informatics. The University of Hildesheim Foundation cooperates with more than 160 universities or institutions of tertiary education in 40 countries and makes more than 400 student exchange places available annually. The University received the European Quality Label in 2007 and again in 2011 and was the sole German university to be honored by the European Union for its Erasmus success story in 2010. The students appreciate the compact campus with approx. 6.000 students and over 400 staff. There is a very personal atmosphere of learning with first-class tutoring and theory and practice are closely combined, the latter being a guiding principle of the University Foundation. The University of Hildesheim is thus the perfect place for the first Open Landscapes Conference.

The Open Landscapes 2013 conference should bring together researchers from all over the world that have a focus on open landscape habitats. The conference will cover a wide range of topics including ecological pattern and processes in undisturbed and disturbed ecosystems; consequences of global change for biodiversity and/or ecosystem services; plant-animal relationships; tools and targets for ecosystem restoration and innovative strategies for nature conservation. With about 250 participants coming from 25 countries the conference is highly international. By a look into the conference program you will agree that the conference has a high scientific level with several sessions which focus on very different aspects of open and semi-open landscape habitats. As global change, ecosystem degradation and biodiversity loss are ongoing problems, one of the main goals of the conference is to find new conservation methods and alternative management tools to preserve open landscapes habitats such as heathlands, coastal ecosystems or dry meadows for future generations. Further, of course, we will discuss how open landscapes have developed in Europe, which role large herbivores have played in the past and which role they play today.

The presence of six highly reputed keynote speakers represents a great value to our program. I am happy that the SER-Europe, the Ecological Society of Germany, Austria & Switzerland (GfÖ), the European Dry Grasland Group (EDGG) and the NABU have agreed to be involved into the conference.

Finally, I like to thank all people involved for making this conference possible: the keynote speakers which highly enrich the conference by their presentations; the session chairs for putting the program together; the scientific committee for their input; the excursion leaders; all members of the Ecology and Environmental Education Group and the Institute of Biology and Chemistry- without whom I would be lost; the SER-Europe, GfÖ, EDGG and NABU for their help and scientific input; the DFG and Sparkasse Hildesheim for their financial support; and you, the participants who came to Hildesheim to join this exciting conference.

I am looking forward to five days stimulating oral and poster presentations which will all focus on Open Landscapes.

Jasmin Mantilla Contreras

Chair of Open Landscapes 2013

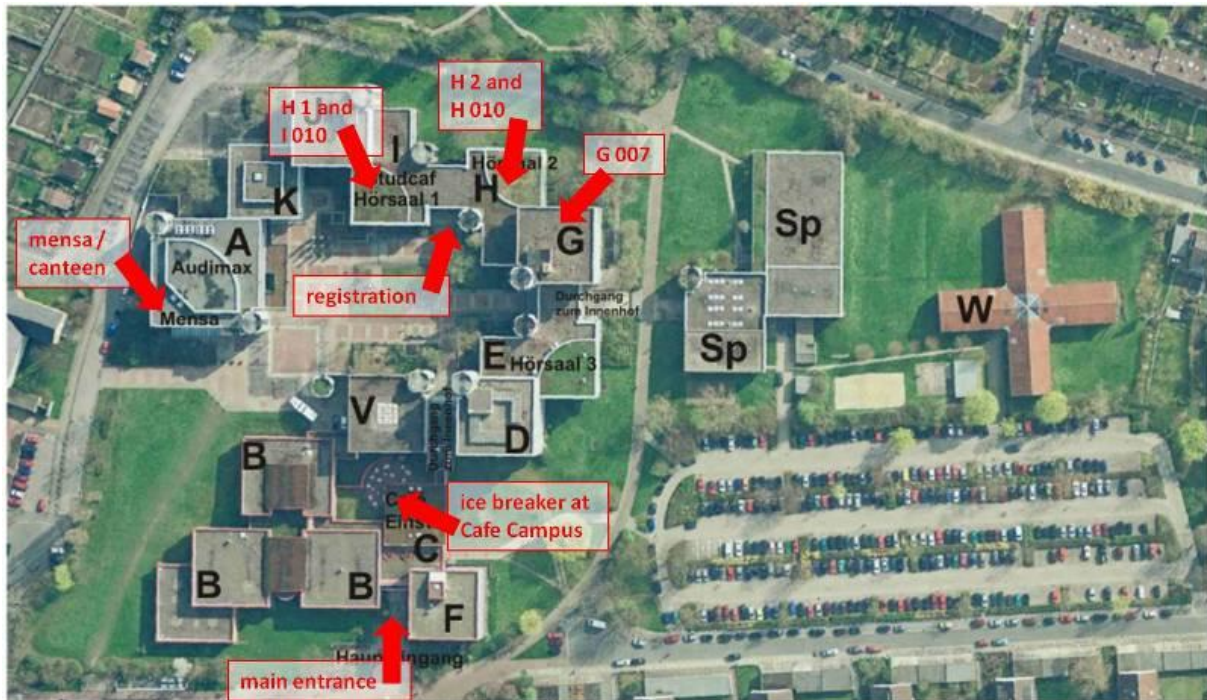
Ice Breaker

Meet new and old colleagues and get a first impression of the University of Hildesheim by having some snacks and drinks at the “Café campus”. The Ice Breaker is included in the conference fee.

When: Sunday, 29th September, 7 pm – approx. 12 pm

Venue: Café Campus, main campus of the University of Hildesheim

Address: Marienburger Platz 22, 31141 Hildesheim



Conference Dinner

When: Tuesday, 1st October, 7:30 pm – approx. 12 pm

Venue: Novotel Hildesheim

Address: Bahnhofsallee 38, 31134 Hildesheim



Fee: 40 Euro including an Italian buffet with lot of choices and some drinks

How to get there:

From the Conference Venue (Marienburger Platz 22) take bus number 3, direction "Hauptbahnhof/Hildesheimer Wald" and get off at the Central station (Hauptbahnhof). From the Central station walk through the "Bahnhofsallee" to the Hotel (5-10 minutes). You can also take bus number 4 (104 in the evening), direction "Im Koken-Hof/Bockfeld" and get off in the City centre (Hindenburgplatz or Schuhstrasse) and walk from there (approx. 15 minutes).

City tours

We offer two city tours (in English) where you will take a walk through the main attractions of Hildesheim. A registration for the city tours is not necessary and the price for the tour is already included in your conference fee. If you take the city tour on Sunday, it is NOT necessary to register prior to the conference, you can just go to the meeting point.

When: Sunday, 29th September, 4 pm to 6 pm or Wednesday, 3rd October, 6:30 to 8:30 pm

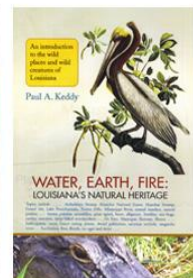
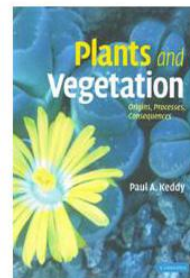
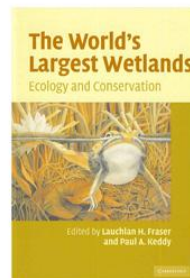
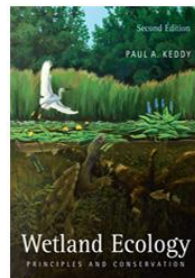
Where: City centre, historical market place (Tourist Information)



Keynotes

Paul A. Keddy **Restoring and maintaining biodiversity in semi-natural open landscapes: bridging the oceanic divide**

Monday, 30th September, 9:30 am



Semi-natural open landscapes, the theme of this conference, provide an opportunity for us to collectively re-examine one of the most profound issues facing humanity—how to maintain and expand the habitat for the many wild species with which we share earth. How do open landscapes fit into a world which varies along a continuum from dense cities to strict wilderness? We need to look carefully at both the science that we have done, and the attitudes with which we apply that science. How we might do better in the future? A particular challenge is to restore natural driving forces that create open non-forested landscapes, such as natural water level fluctuations in lakes and floodplains.

I will begin by exploring some of the attitudinal differences between North America and Europe, to wild areas, at least as I have experienced them in writing and in travel. I will describe the problems this dichotomy creates, and then suggest how they can be transformed into opportunities. Some examples will likely include Great Lakes wetlands, Gulf coast pine savannas, and European limestone grasslands.

In a more technical section, I will present a short list of the models we have for managing and enhancing biodiversity, and some of the observational and experimental data that support them. I will suggest that we already have many of the tools we need, and the challenge is to accelerate the application of existing knowledge.

I will close by reemphasizing that the rules of science do not change from Sicily to northern Germany, nor from Louisiana to the Great Lakes, so we can share the same principles wherever we live and whatever language we speak. If we take the right view (general models with regional calibration) and the right action (applying a consistent set of management tools based upon rigorous science) we should be pleasantly surprised by the many wild places we can create, restore and maintain.

Oswaldo Sala Functioning of grasslands and savannas around the world

Monday, 30th September, 2 pm

Grasslands and savannas occupy 40% of the terrestrial surface. Primary production of this large region provides a supporting ecosystem service that affects 6.5 billion people who live in these ecosystems and many other individuals that although do not live in grasslands are affected indirectly by the condition of grasslands around the world. Primary production at a regional scale is controlled primarily by annual precipitation that accounts for more than 90% of the regional variability in production. However, our understanding of temporal patterns of primary production and its controls is much weaker. Inter-annual variability in precipitation explains only 20-25% of the variability in production. I hypothesize that lags in the response of grassland ecosystems to changes in precipitation mask the relationship between production and precipitation. Legacies of previous dry or wet years would account for a large fraction of inter-annual variability of production and represent the mechanism behind time lags. I will present results from experiments in different grassland ecosystems that explored the existence of legacies and their mechanisms. One of these experiments experimentally created dry-wet and wet-dry transitions. Legacies in ANPP were similar in absolute value for dry-to-wet or wet-to-dry transitions in precipitation and their magnitude was a function of the difference between previous and current-year precipitation. Changes in tiller density accounted for 40% of legacy variability while nitrogen availability showed no effect on legacies. Mechanisms that control productivity response to intra-annual precipitation patterns are important to predict ANPP responses to climate-change induced increased precipitation variability.



Iris Möller**Bio-physical linkages and the management of coastal ecosystems: issues of thresholds and scale**Monday, 30th September, 7 pm

It is estimated that currently more than 40% of the world's population lives within 100 km of the coast, and much of this settlement is at low elevations. The fact that this figure is on the increase, alongside the fact that many densely populated coasts are experiencing accelerated rates of sea level rise and that low-lying coastal environments are increasingly seen as providing a wide range of 'ecosystem services', such as coastal defence, highlights the importance of understanding the functioning of the ecosystems in these coastal 'buffer zones'. While coastal wetlands have, for many decades, fascinated ecologists and geomorphologists alike, the study of their 'engineering significance' is relatively recent. This talk will explore the linkage between the ecological and physical functioning of a range of coastal wetland systems, such as mangroves, saltmarshes, and reed beds, and how our study of those bio-physical linkages has advanced over recent decades. Field and numerical modelling studies suggest both ecological adaptation mechanisms to physical stressors as well as the importance of vegetation to landform evolution. In recent years, however, the importance of understanding the linkages between the biological and physical factors that control coastal wetland functioning and evolution has been brought into focus within the conservation, engineering, and policy sector. This is largely the result of a rising awareness of the value of coastal wetlands resulting from the services they provide to society. Those services include their role as natural sea defences. Over the past quarter of a century, advances in field, laboratory, and numerical modeling approaches have made particular inroads into the quantification of the sea defence role of coastal wetlands. It is becoming increasingly clear that the sea defence function itself is complex and highly context dependent. Although there is now an urgent need for improved ecologically-informed engineering solutions, these are unlikely to be successful without future research finding appropriate ways of scaling up hydraulically important parameters to the landscape scale and defining the physical and biological process thresholds that control the continued provisioning of the sea defence function of coastal wetlands in the face of potential extreme events and sea level rise.



Roland Bobbink **Increased atmospheric N deposition and the restoration of formerly species-rich heathlands and grasslands: constraints and possibilities for the future**

Tuesday, 1st October, 8:40 am

Atmospheric nitrogen deposition, from both oxidised (NO_y) and reduced (NH_x) compounds, is nowadays one of the main threats for biodiversity in European semi-natural ecosystems of high conservational value. Long-term nitrogen input from the atmosphere may cause eutrophication, soil acidification and/or ammonium toxicity. The severity of these impact depends on the biogeochemistry of the particular ecosystem, but is especially severe under oligo- to mesotrophic, weakly buffered soil conditions.



Long-term field trials have been set up in deteriorated ecosystems such as grassland and heathland sites since the early 1990s to counteract the severe impacts of N pollutants. The first aim was to restore former soil conditions, as we feel that rehabilitation of ecosystems should start with recreating appropriate abiotic conditions. Removal of the vegetation and top soil ('sod cutting'), liming, hydrological measures or a combination of them were used depending on the actual biogeochemical constraints after the degradation. The effectiveness was mostly evaluated by following the soil chemistry and plant composition. In this presentation an overview of the experimental restoration measures and the main factors of success or failure will be presented. In most cases a combination of measures proved to be successful in restoring appropriate soil conditions and a low productive sward. A full recovery of plant diversity was, however, seriously limited when the characteristic species had already disappeared, especially in dry conditions or when it was impossible to increase the soil buffer capacity after acidification. Additional measures to counteract the dispersal limitation of many endangered species may be needed. Finally, it is concluded that an decrease in atmospheric N deposition is still needed in several areas of Europe to protect sensitive ecosystems on the longer term.

Jan Lepš

Keeping open landscapes open and species rich - management and succession in semi-natural habitats

Tuesday, 1st October, 1:40 pm

Without human intervention, the central European landscape would be mostly forested. Still, the semi-natural grasslands (the term used for the grasslands under extensive traditional management, i.e. mowing or grazing) are among the most species rich communities here. At the same time, they are among the most endangered communities, because their management is not economical any longer. As a consequence, their management is either intensified (higher fertilization, more frequent cutting), or they are abandoned and undergo successional development. Both usually lead to fast loss of their species diversity.

In my talk, I want to discuss experiments which we have done, and which aim to explain why the species are lost, how we can reverse the species loss, and also, why the increase of productivity leads to tremendous loss of species diversity, whereas the biodiversity experiments predict positive relationship between diversity and species richness. Many of these and other open habitats in Central Europe undergo secondary succession toward forest, but in some, the succession toward forest is hindered, mostly by competition of strong competitive grasses.

I will first review 20 years of the experiments in our experimental locality Ohrazení, where we aim to disentangle the effect of dispersal limitation, environmental filtering, and competitive exclusion on the species richness and species composition to grassland communities. In particular, I want to stress the scale dependence of species richness response to increased nutrients, and to various levels of disturbance. Then, I want to discuss (not only our) biodiversity experiments (i.e. the experiments, where the species richness is experimentally varied and community productivity is evaluated as the response to species richness), and how these results can be reconciled with the well-known phenomenon of decreasing diversity under increased nutrients in meadows, or with the humped back model of richness response to productivity. Finally, from a more practical point of view, I will demonstrate our experiment in Slovak Carpathians, showing that it is less economically demanding to continue the management to keep rich species composition in meadows, than to restore species richness in abandoned species poor communities.

Finally, both the abandoned meadows and abandoned fields undergo secondary succession toward forest. Using an example from our old-field succession study, I want to discuss the role of initial conditions, i.e. condition in the time of abandonment, and how they determine the successional pathway, in particular, how they determine whether the succession will go fast towards woody communities, or whether we will get for a long time open community dominated by competitive grasses.



Michael Kleyer Plant functional strategies in patterned landscapes – responses to the environment and effects on ecosystem properties

Wednesday, 2nd October, 9 am

Plants need to secure growth, persistence, regeneration and dispersal in patterned landscapes. Increasing biomass allocation to one of these functions requires a proportional allocation increase or decrease to the other functions, indicated by positive or negative scaling relationships among traits associated with these functions. Combining the analysis of scaling relationships among traits with their responses to environmental conditions reveals how plant functional strategies change on environmental gradients. Changes in functional strategies often also affect ecosystem properties such as vegetation and soil carbon stocks. In this presentation, I will present some case studies demonstrating how functional strategies respond to the environment and affect ecosystem properties.



Detailed Program

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Sunday, 29th September				
4:00-6:00 pm	City tour Hildesheim (Marktplatz, City Centre)			
from 5 pm	Registration			
7:00-11:00 pm	Ice Breaker			
Monday, 30th September				
9:00-9:30 am	Opening ceremony			
9:30-11:00	Opening Keynote Paul A. Keddy (H 2)			
11:00-11:20	Coffee			
	Session OL1/2 (H 2)	Session G1 (H 1)	Session A1 (I 010)	Session B1 (G 007)
11:20-11:40	OL1/2 S.Stiegel: Open landscapes in Europe: The role of megaherbivores	G1 L.Sutcliffe: Local and landscape effects on plant and Orthoptera diversity in semi-natural grasslands in Southern Transylvania, Romania	A1 P.O.Waeber: Sticking one's head out of Madagascar's forests	B1 A.Brunbjerg: Reintroducing disturbances in coastal dunes
11:40-12:00	OL1/2 B.Lysakowski: Water buffalos in biodiversity conservation	G1 O.Valkó: Effects of surroundings and environmental variables on alkali grassland recovery in grassland restoration projects	A1 J.U.Ganzhorn: Turning Madagascar upside down	B1 H.Fabritius: False heath fritillary meadows: modelling succession and spatio-temporal connectivity of the habitat network
12:00-12:20	OL1/2 D.Bautze: The importance of scavenger communities in open landscapes	G1 E.Horčíčková: Disturbance regime and diversity in semi-dry grasslands caused by wild ungulates	A1 J.Rasonomenjanahary: Study of movements and territory occupation of Tenrecidae in the dry forest of Ankarafantsika National Park	B1 E.Chaideftou: How the biodiversity is affected by varied fire intensity? A case study in a Mediterranean island (Zante, Greece) using plant and bird taxa

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12:20-12:40	OL 1/2 T.Reitalu: Diversity components of 14000-year palynological record – richness, evenness and phylogenetic diversity – in relation to landscape openness	G1 B.Schmitt: Establishment success in a seeding experiment in grasslands of different land use	A1 Y.R.Ratovonamana: Plant phenology of Madagascar dry spiny forest in relation to recent climate change	B1 H.Mayerová: Limestone quarry landfill next to valuable dry grassland – will they share biodiversity?
12:40-1:00	OL 1/2 C.Fløjgaard: What do they eat? Using DNA barcoding to assess diet preferences of deer	G1 M.Probo: Pastoral practices for the restoration of sub-alpine open habitats: short-term effects on vegetation and dung beetles	A1 R.Fricke: Effects of ecosystem degradation on plant and animal biodiversity in the Mahafaly plateau, SW-Madagascar	
1:00-2:00	Lunch			
2:00-3:20	Keynote Osvaldo Sala (H 2)			
	Session OL1/2 continued (H 2)	Session G1 continued (H 1)	Session A1 continued (I 010)	Session B1 continued (G 007)
3:20-3:40	OL 1/2 K.Fleischer: Cattle foraging habits benefit vegetation structure diversity and Orthoptera under year-round grazing	G1 B.Tóthmérés: Biomass-plant species richness relationship in alkali grasslands along a long productivity gradient	A1 J.Lavialle: To restore natural capital around the Madagascar lowland rainforest fragment of Analalava (Foulpointe): meet needs and concerns of local population	B1 C.Neubeck: Project „Yellow-bellied toads in Northern Hesse“ - The yellow-bellied toad (<i>Bombina variegata</i>) as indicator species for the revitalisation of submontaneous floodplains in Northern Hesse
3:40-4:00	OL 1/2 P.B.M.Pedersen: Rewilding status in Denmark	G1 D.Lafage: NDVI can predict species richness and abundance of ground beetles in temperate floodplains	A1 K.Thielsen: Decision-making processes in natural resource management among the Tanalana (south-west Madagascar)	B1 M.Nadjafzadeh: Consolidation and integration of yellow-bellied toad populations (<i>Bombina variegata</i>) in Germany

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4:00-4:20	OL1/2 S.Venn: Creating dry meadow habitats to support the diversity of pollinating insects in urban regions	G1 J. Pétilion: Impact of burning, cutting and grazing on ground-dwelling arthropods from grasslands and salt meadows of Brittany and Normandy (Western France)	A1 T.Richter: The Alaotra Marshland Biodiversity Project (AMBio) at Lake Alaotra, Madagascar – preserving biodiversity for future generations while enhancing local livelihoods	B1 K.Knorr: Genetic population structure of the yellow-bellied toad (<i>Bombina variegata</i>) in time and space. Implications for conservation
4:20-4:40		G1 E.Riedener: Effects of irrigation and land use abandonment on the biodiversity of mountain hay meadows in the Valais, Switzerland	A1 T.Rakotoarisoa: <i>Eichhornia crassipes</i>, curse or opportunity for local stakeholders at Lake Alaotra?	
4:40-5:00	Coffee			
	Session W 1 (H 2)	Session G1 continued (H 1)	Session A1 continued (I 010)	
5:00-5:20	W1 K.Edwards: The effect of different temperatures on the growth and physiology of invasive <i>Lythrum salicaria</i> L.	G1 Z. Kacki: Formalized classification of meadows communities of Molinio-Arrhenatheretea class in Poland: new insight into differentiation and nature conservation problems	A1 L.M.Reibelt: Are the future resource users aware of their environment? Environmental education in its infancy at Lake Alaotra, Madagascar	
5:20-5:40	W1 J.Květ: Production ecology and aggressive behaviour of <i>Phalaris arundinacea</i> L. in Central Europe	G1 A.Kelemen: Ceased post-restoration management by mowing leads to fast degradation of restored grasslands: a field study from Hungary	A1 F.Rakotoarisoa: Influence of fire and grazing on the floristic richness and diversity of the savannas of East of Madagascar (case-Mahabo Mananivo)	
5:40-6:00	W1 N.Mogha: Plant communities of East African wetlands and their relationships with land uses and soil properties	G1 J.Dengler: Expansion of <i>Calamagrostis epigejos</i> in sandy grasslands of the Middle Elbe Valley - effect on biodiversity of flora and grasshoppers and effectiveness of management methods		

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6:00-6:20	W1 P.L. Lammers: The influence of invasive water hyacinth (<i>Eichhornia crassipes</i>) on the Alaotra wetlands, Madagascar's most important rice and fish production area	G1 B.Deák: Fire as an alternative management tool – adaptation of North-American grassland burning practices to European grassland conservation	
6:20-6:40	W1 J.Mantilla-Contreras: Impact of invasive plant species on the habitat quality of the Alaotran Gentle Lemur (<i>Hapalemur alaotrenis</i>) at Lake Alaotra, Madagascar		
6:40-7:00			
7:00-8:20 pm	Evening Keynote Iris Möller (H 2)		
Tuesday, 1st October			
8:40-10:00 am	Keynote Roland Bobbink (H 2)		
10:00-10:20	Coffee		
	Session OL3 (I 010)	Session B2 (H 2)	Session F1 (H 1)
10:20-10:40	OL3 S.Willinghöfer: Water balance of <i>Kobresia pygmaea</i> pastures under the effects of climate change	B2 A.Blaschka: Induced changes in vegetation: An estimation of thresholds	F1 A.Varga: Driving forces of the Hungarian wood-pasture management in the last 200 years
10:40-11:00	OL3 S.Mobaied: Effects of soils and topography on the dynamics of forest – heathland communities	B2 S.Klimek: Impact of grazing management and distance from farm building on orthopteran and butterfly diversity in Alpine summer pastures	F1 L.Cizek: Erasing a European biodiversity hot-spot: Forestry intensification and succession turns open woodlands into forest plantations in UNESCO Biosphere Reserve
11:00-11:20	OL3 G.Stuhldreher: When habitat management can be a bad thing – the habitat preferences of the Woodland Ringlet (<i>Erebia medusa</i>) in Central Germany	B2 M.Gebhardt: Social and ecological feasibility of range management recommendations for the Javakheti Highland, Caucasus.	F1 M.Röllig: Traditional wood-pastures in southern Transylvania: characteristics, biodiversity and threats

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11:20-11:40	OL3 D.Gabriel: Modelling the spatial distribution of species-rich farmland to identify priority areas for conservation actions at regional scales in Germany	B2 J.Treitler: Influence of grazing, topography and microclimate on the biodiversity of the National Park Asinara	F1 J.Marull: Exploring the links between forest transition and landscape changes in the Mediterranean. Can forest recovery lead to lower landscape quality?
11:40-12:00	OL3 E.Davarynejad: Prediction of presence and absence of insect species from land cover and climatic data using an Adaptive Neuro Fuzzy Inference System (ANFIS) model	B2 O.Dennis: Conversion of humid savanna into agro-ecosystems: Impacts on species composition, carbon dioxide exchange and carbon storage in the herbaceous vegetation	F1 J.Vojta: Shrubs in pastures enhance vegetation heterogeneity
12:00-12:20	OL3 T.Fartmann: Survival in fragmented landscapes: the role of functional connectivity for patch occupancy in grassland specialists	B2 M.El-Sheikh: Floristic diversity and vegetation analysis of Wadi Al-Noman, Holy Mecca, Saudi Arabia	F1 K.Henning: Alternative land use options for large scale heathland ecosystems
12:20-12:40	OL3 M.Streitberger: Molehills as important larval habitats for the Grizzled Skipper (<i>Pyrgus malvae</i>) in calcareous grasslands		F1 G.Rosenthal: Wood pastures in Upper Bavaria - impact of changed grazing on succession and biodiversity of different spatial scales
12:40-1:40	Lunch		
1:40-3:00	Keynote Jan Lepš (H 2)		
	Session W2 (I 010)	Session G2 (H 2)	Session F 1 continued (H 1)
3:00-3:20	W2 A.Garbutt: A review of the state of knowledge of climate change impacts and mitigation in coastal ecosystems	G2 M.WallisDeVries: Restoring insect diversity on calcareous grasslands: the importance of microclimate (Session Keynote)	F1 K.Schulze: Epizoochory via the hooves - the European bison (<i>Bison bonasus</i> L.) as a dispersal agent of seeds in an open-forest-mosaic
3:20-3:40	W2 A.Koch: Trade-offs in ecosystem functions and services of Baltic coastal ecosystems with respect to climate change and coastal protection	G2 M.WallisDeVries continued	F1 J.VanUytvanck: How to use domestic large herbivores in restoring woodpasture landscapes on former agricultural land

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3:40-4:00	W2 M.Heuner: Effects of regional climate change for marsh vegetation along the Weser and Elbe estuaries	G2 T.Conradi: Integrating local and regional processes in management and restoration of calcareous grassland metacommunities	F1 K.Kirby: What might a sustainable population of trees in wood-pasture sites look like?
4:00-4:20	W2 R.Pätsch: Salt grasslands along the german and polish Baltic Sea coast and the influence of wild grazing animals	G2 M.Jeschke: Effects of current and past management on calcareous grassland vegetation and the role of dispersal in grassland management	F1 A.Peringer: The emergence of semi-open landscapes from multiple disturbance regimes: a simulation study in the Swiss Jura mountains
4:20-4:40	Coffee		
	Session W2 continued (I 010)	Session G2 continued (H 2)	Session AL1/2 (G 007)
4:40-5:00	W2 K.L.Spencer: Linking sediment structure, hydrological functioning and biogeochemical cycling following de-embankment of restored coastal saltmarshes	G2 B.Bauer: Pasture management affects land snail diversity in nutrient-poor calcareous grasslands	AL 1/2: R.Bucher: Effects of habitat isolation and habitat amount on wolf spiders in agricultural landscapes
5:00-5:20	W2 J.Trinogga: Functional trait diversity along abiotic gradients and its effect on ecosystem properties in wetlands	G2 A.Helm: Extinction debt and invasion of non-characteristic species in European calcareous grasslands	AL 1/2 M.A.Cebrián: Sustainable management in coastal grasslands: Trade-offs between ecosystem services
5:20-5:40	W2 J.Pétilion: Success of managed realignments for the restoration of arthropod communities in Essex (UK)	G2 E.Giarrizzo: Thirty years of changes in the extent and vascular plant species composition of <i>Bromus erectus</i> semi-natural grasslands	AL 1/2 A.Khaled: Natural areas of northern Algeria: agricultural issues and environmental future
5:40-6:00	W2 K.Mazik: Restoring estuarine wetlands – ‘good for the ecology’ or merely ‘good for the ecologists’?	G2 M.Evju: Effects of fragmentation on plant communities in dry calcareous meadows – the importance of species traits	AL 1/2 C. Seifert: How do different bioenergy plant production systems affect farmland phytodiversity?
6:00-6:20	W2 J.Pétilion: Impact of human disturbances on the diet of young fish in tidal saltmarshes	G2 H.P.Rusterholz: Delayed response in a plant-pollinator system to experimental grassland fragmentation	AL 1/2 C.A.López-Santiago: Exploring stakeholders’ appreciation of cultural landscapes through visual perception of ecosystem services: the case of transhumance in Mediterranean Spain

Detailed Program

6:20-6:40	W2 A.Piernik: Main driving factors for seacoast vegetation in southern Baltic	G2 P.Sengl: The fate of small, isolated patches of semi-dry grassland (Cirsio pannonici-Brometum) – A case study in South-Eastern Styria (from 2007 – 2013)	
6:40-7:00		G2 V.Rösch: Small versus large fragments of calcareous grasslands: species richness is similar but community composition differs across four taxa	
7:30-12:00 pm	Conference Dinner Novotel		
Wednesday, 2nd October			
9:00-10:20 am	Keynote Michael Kleyer (H 2)		
10:20-10:40	Coffee		
	Session H1 (I 010)	Session F2 (G 007)	Session G3 (H 2)
10:40-11:00	H1 S.Bacchereti: LIFE Nature for heathland management and conservation: examples and best practices	F2 J.Horák: From species to multi-taxa level: The beneficial effect of canopy openness in temperate woodlands	G3 I.Jongepierová: The use of target Bromion species for restoration of grasslands in the Bílé Karpaty Mts.
11:00-11:20	H1 G.von Oheimb: Interactive effects of important global change drivers on heathland ecosystems	F2 P.Sebek: Effect of active conservation management on biodiversity: Multi-taxa survey in oak woodlands of Podyji National Park, Czech Republic	G3 W.Graiss: Restoration of semi-natural litter meadows in the Enns valley
11:20-11:40	H1 C.Scherber: Effects of global change on plant-insect and above-belowground interactions in a Danish heathland	F2 J.Buse: Tree quality and connectivity affects trophic structure of saproxylic beetle assemblages inhabiting old oaks	G3 N.Hözel: Restoration of alluvial NATURA 2000 grassland habitat by topsoil removal and species transfer with green hay – results from long-term monitoring study over 15 years

Detailed Program

11:40-12:00	H1 F.Bochard: Effects of montane heathland restoration on leafhoppers (Auchenorrhyncha)	F2 D.Nagy: Biodiversity of rove beetles (Staphylinidae) along grassland-forest transects in North-East Hungary	G3 R.Buchwald: Successful restoration of mesophilous grassland: Which factors are most important? A long-year study (2004-2012) of hay transfer in Germany
12:00-12:20	H1 J.Vogels: Nitrogen and acid deposition induced stoichiometric shifts in heathland soils and plants: the missing link between air pollution and fauna decline in heathlands?		G3 F.Richter: Introduction of endangered plant species – experiences from meadows in Saxony
12:20-2:00	Lunch		
	Session N1 (I 010)	Session W3 (G 007)	Session G3 continued (H 2)
2:00-2:20	N1 V.Minden: Relationships between plant traits: a comparison of stoichiometric, plant allocation-, size- and morphology-related traits of plant species of a german salt marsh	W3 S.Baccherti: LIFE Nature for freshwater ecosystems: examples and best practices on the restoration of running waters	G3 S.Dullau: Evaluation of grassland restoration success – a method for multiple project application
2:20-2:40	N1 D.Andersen: Habitat requirements of the endangered orchid <i>Liparis loeselii</i> in Danish rich fens	W3 H.Markus-Michalczyk: Is restoration of willow softwood forests in tidal wetlands possible	G3 K.May: Hay transfer, sowing of regional seed mixtures and threshing material: Results from trials to enrich species-poor meadows
2:40-3:00	N1 S.Schelfhout: Restoration of species-rich <i>Nardus</i> grasslands: exploring the technique of phosphorus mining	W3 E.Mosner: Climate change and floodplain vegetation - potential effects of hydrologic alterations on the habitat availability of riparian plant species	G3 H.John: Successful establishment of target species on a nutrient rich degenerated half-bog meadow
3:00-3:20	N1 C.Faust: Successional pathways under different nutrient regimes: lessons from a pioneer grassland	W3 K.Ludewig: Effects of reduced precipitation on the fodder quality of floodplain meadows along the Elbe and Rhine Rivers	

Detailed Program

3:20-3:40	Discussion		
3:40-4:00	Coffee		
4:00-4:40	Final discussion (H 2)		
	Poster Sessions		
4:40-7:00			
Thursday, 3rd October			
Full day	Excursion: Lüneburger Heide	Excursion: Ith und Solling	Excursion: Wisentgehege Springe
6:30-8:30pm	City tour Hildesheim (Marktplatz, City Centre)		

Nature reserve “Lüneburger Heath” – Wednesday, 3rd October

This excursion will give an introduction to the ecology and conservation of heathland ecosystems typical of the lowlands of NW Germany. The nature reserve “Lüneburg Heath” comprises an area of about 230 km² and is the largest and oldest nature reserve in Lower Saxony (established in 1921). The Lüneburg Heath preserves the largest complex of heathlands in NW Germany (about 5,000 ha). The nature reserve is characterized by Pleistocene sandy deposits, and prevailing soil types are nutrient-poor Podzols or podzolic soils with low pH values. The climate is of a humid sub-oceanic type.

Heathlands are old cultural landscapes (> 1000 years) typical of NW Europe. The area of heathlands, however, has declined dramatically since the second half of the 19th century, mainly due to shifts in land use practices and the introduction of artificial fertiliser. In the lowlands, more than 90% of the former heath area has disappeared over the last 150 years. Thus, heaths are nowadays regarded as an internationally endangered habitat type of high conservation value, and current conservation efforts are directed towards the preservation of heathland biodiversity.

In step with the loss of heathlands, most of the remaining areas have been subjected to changes in vegetation structure and species composition in recent decades, mainly as a result of high airborne nitrogen loads. The Landscape Ecology Group at the Institute of Ecology maintains permanent plots in the Lüneburg Heath in order to analyse ecosystem responses to and the long-term fate of N inputs in lowland heaths. The excursion will give information about recent shifts in the species composition of heaths and will highlight current perspectives to maintain balanced nutrient budgets by means of different management measures (sod-cutting, mowing, grazing, prescribed burning) to preserve heathland biodiversity.

Organization: Werner Härdtle, Leuphana University of Lüneburg

Departure time: 8:00 am / Return time: approx. 5:30 pm

Meeting point: The excursion will start at the parking place of the University, Marienburger Platz 22

Meadows, bogs and wood pastures in the mountain ranges Ith and Solling

The excursion comprises a couple of landscape elements, extremely different in ecology and management. At first, the bus will take us to the Ith mountains southwest of Hildesheim. There, we will encounter species-rich grassland communities on limestone and discuss their origin and methods of their conservation.

Active raised bogs on top of the Solling mountains will be the next stop-over. We will have time to explore the remnants of a once widespread habitat on acidic substrate. A paved trail will lead us into the wet heart of the *Mecklenbruch* mire where we will take a close look at a good example of long term bog restoration.

Along the whole trip we will get an insight into different types of managed forests. Getting to our last stop of the excursion, we can compare our impression of those “typical” forests with that of a management regime very rare for Central Europe: A grazed forest associated with the wood pasture project *Reiherbachtal*. We offer a diverse and colourful excursion and invite to lively discussions.

Organization: Inga Schmiedel & Florian Goedecke, University of Göttingen,

Departure time: 8:00 am / Return time: approx. 6 pm

Meeting point: The excursion will start at the parking place of the University, Marienburger Platz 22

Wisentgehege Springe

On this excursion, we will visit the Wisentgehege Springe, located south of Hanover. On 90 ha of meadows and old trees more than 100 (critically) endangered, mostly European species are maintained in a nature friendly environment. For over 80 years, the main goal of the park is to prevent those species from extinction. Founded in 1928, the first purpose of the park was to establish a conservation breeding program for the European bison, whose last wild populations were extinct in the wilderness during in the twenties of the last century. Several conservation breeding programs have contributed to the current survival of the species and to a reintroduction of the species to its natural habitats. Conservation breeding is still an important goal of the Wisentgehege. Besides the European bison, the park has a conservation breeding program for Przewalski horses, wolverines, Eurasian eagle owls, Persian fallow deers and European wild cats. The Wisentgehege promotes several rewilding projects and has frequently released species into the wilderness. Przewalski horses from the Wisentgehege have helped to establish new populations in Mongolia and in China. European bisons from the park have been reintroduced into the wilderness since the fifties of the last century. Currently, the park is working on a breeding program of the Persian fallow deer, a species that is currently extinct in the wilderness. There are about 200 individuals left in European zoos and game reserves. In 2004 and 2005, the first four calves were born in the Wisentgehege. If the conditions allow it, the park will pursue a resettlement of the species into the wilderness in the closer future.

We will explore the park on a six-kilometer trail through forest and open landscape habitats. We will discuss how large herbivores could have contributed to the open habitats in Europe and how they can be used as a tool for nature conservation and for restoration purposes. Further, we will discuss general aspects on rewilding and the benefits and limitations of the re-introduction of species to nature.

Organization: Jasmin Mantilla-Contreras, University of Hildesheim

Departure time: 9 am / Return time: 3 pm

Meeting Point: The excursion will start at the parking place of the University, Marienburger Platz 22

Abstracts

SESSION W1 - THE ROLE OF EXPANSIVE NATIVE AND INVASIVE ALIEN PLANTS IN THE FUNCTIONING OF INTACT, DEGRADED AND RESTORED FRESHWATER WETLANDS

Chairs: **J. Květ¹ & K. Edwards¹**

¹*University of South Bohemia, České Budějovice, Czech Republic*

This session will have in focus: (a) the biology, performance and functioning of both expansive native and invasive alien plants in preferably non-forested freshwater wetlands; and (b) the changes in the water, carbon and mineral nutrient budgets, turnovers and cycling in restored versus intact natural and/or degraded freshwater non-forested wetlands. It will be most welcome if these two topics are combined with each other in particular contributions, either oral or poster ones. This approach involves, for example, assessments of some of the processes mentioned above in relation to the success or failure of populations of certain invasive and/or expansive plant species in the wetland(s) in question. Attempts at extrapolating the results obtained to the landscape scale are desirable. The contributions may present results from any biogeographical region(s) of the world and can make comparisons between them as well as between various wetlands occurring in different types of open landscapes within one region.

O1 - THE EFFECT OF DIFFERENT TEMPERATURES ON THE GROWTH AND PHYSIOLOGY OF INVASIVE *LYTHRUM SALICARIA* L.

K. Edwards¹, D. Bastlova¹ & J. Květ¹

¹*University of South Bohemia, Faculty of Science, Department of Ecosystem Biology, České Budějovice, Czech Republic
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It is predicted that increased atmospheric CO₂ will result in warmer temperatures overall. Warmer conditions, in league with other changes such as increased nitrogen availability, should lead to increased spread of already known invasive species, as well as allowing currently non-invasive species to become more aggressive in the future. This should also be the case for aggressive wetland plant species. We conducted several experiments investigating the effect of temperature on life history characteristics and physiological parameters of invasive populations of *Lythrum salicaria* L. (purple loosestrife). Populations collected along a latitudinal gradient from central North America were grown in common gardens in the Czech Republic (cooler climate) and southern Louisiana (warmer climate) and their growth, height and biomass allocation patterns was measured. All of the invasive populations responded in a similar manner to increased temperature conditions, being larger and allocating more mass to aboveground structures in the Louisiana common garden compared to the cooler Czech conditions. In addition, native plants from different latitudes, with correspondingly different ambient temperature and day length regimes, were grown at the same temperature. Measured values of net assimilation rates showed very high variability between and within locations and no significant trend was observed. Similar results (without significant differences) were observed in chlorophyll content in the studied plants. These results indicate that any between-population differences in life history traits are not due to differences in physiology. Overall, it appears that invasive populations from central North America have not yet developed latitudinal clines like those from the east coast of North America and that phenotypic plasticity is still the dominant factor affecting the growth and spread of the central populations.

O2 - PRODUCTION ECOLOGY AND AGGRESSIVE BEHAVIOUR OF *PHALARIS ARUNDINACEA* L. IN CENTRAL EUROPE

J. Květ¹, K. Edwards¹, H. Čížková² & D. Bastlová¹

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Phalaris arundinacea L., Reed Canary Grass, is a robust perennial grass spreading mainly by creeping underground rhizomes, sometimes also by new sprouts at internodes of lodged culms. Its caryopses are hydrochorous or anemochorous, germinating on wet soil surface. Its typical habitats are river banks or partly land-filled alluvial water bodies, marshy meadows and alluvial forests. The plants are adapted to intermittent flooding, but are intolerant of long-term anoxia in their root zone. They require good mineral nutrient supply. Originally, Ph.a. occurred in favourable habitats in Eurasia except Iceland. Its presumably secondary occurrence is in temperate North America. In Central Europe, it occurs mainly at altitudes of up to about 700 m. It can be cultivated for forage in a number of cultivars. Ph.a. is suitable for reinforcement of river banks. Ornamental cultivars with striped leaves also exist. The easy spreading of Ph.a. leads to the formation of its monodominant stands, classified into three associations. As admixed species, Ph.a. occurs also in other communities. The establishment of its monodominant stands is associated with its aggressive behaviour. Lack of management (mowing) and increased nutrient supply support its dominance, but regular mowing and higher soil moisture content support Ph.a. competing with other aggressive plants. Vegetative spreading of Ph.a. is associated with the architecture and vertical distribution of its rhizomes and their reserve carbohydrate contents. Different populations (genotypes) of Ph.a. presumably differ genetically in this respect and in aggressiveness. Monodominant Central European Ph.a. stands are highly productive, their aboveground biomass (dry mass) or net production usually being 400 to 1750 g m⁻². Higher recorded values (up to 2300 g m⁻²) may partly be overestimates. Data on belowground biomass (dry mass) of Ph.a. are scanty, usually between several hundreds and about 1500 g m⁻², the seasonal maximum aboveground to belowground biomass ratio being usually about 1; lower values are exceptional. The belowground biomass persists for several years: so the annual belowground net production of Ph.a. is about 50% of its annual aboveground net production, which often widely differs between years, depending on water supply and flood damage to Ph.a. stands. The mineral nutrient contents and fodder quality of Ph.a. aboveground biomass are superior to many other wetland graminoids, but only its young shoots form high-quality forage. The water relations of Ph.a. stands are dynamic, reacting to the stand microclimate and hydrology. Its production processes react to both atmospheric and soil factors. The photosynthetic rate of a whole stand depends on the LAI and vertical distribution of the foliage, although between-population genetic differences may exist in the photosynthetic capacity of Ph.a. leaves. Dead parts of Ph.a., both standing and shed off, decompose slowly so that appreciable amounts of its dead aboveground biomass persist for 1 to 2 years.

O3 - PLANT COMMUNITIES OF EAST AFRICAN WETLANDS AND THEIR RELATIONSHIPS WITH LAND USES AND SOIL PROPERTIES

N. Mogha¹, C. Handa²; B.M. Mösel³ & M. Alvarez³

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In East Africa demographic growth, degradation of upland soils and inter-annual variability of rains is increasing cropping pressure on seasonal and nearly permanent wetlands. Duration and intensity of land use affect distinctly soil properties leading to negative impacts in functions of wetland ecosystems and on potential productivity of the soils. In order to determine effects of land use and soil properties on the species composition of spontaneous vegetation we carried out between 2008 and 2009 a survey in four agriculturally used wetlands of Kenya and Tanzania. Tanzanian wetlands were represented by a lowland floodplain on the West side of the Usambara Mountains and an inland valley in the mentioned mountain range. Kenyan wetlands were represented by a highland floodplain and also an inland valley, both located between the Aberdares mountain range and Mount Kenya. A rapid appraisal with key informants was carried out to determine the characteristic land uses and to collect information on land use history. According to preferential sampling, 10 m² plots representing the main types of land uses were selected. In those plots we recorded all present species and estimated their abundance as percentage cover. In each plot soil samples of the layer 0-15 cm were taken for soil chemical analysis. The vegetation was classified by using hierarchical clustering. To find the relationships between species composition (land uses and plant communities) and soil properties we applied canonical correspondence analysis (CCA). The vegetation is classified into 10 plant communities (clusters), 5 of them are weed communities of croplands. According to the ordination analysis, the most important factors determining the species composition of plots are soil exchangeable K, electric conductivity and pH. Plant communities have a stronger correlation with soil properties than land uses. Interactions between soil and land use properties in the determination of species composition as well as the use of plant assemblages as bio-indicators of wetland status will be discussed.

O4 - THE INFLUENCE OF INVASIVE WATER HYACINTH (*EICHHORNIA CRASSIPES*) ON THE ALAOTRA WETLANDS, MADAGASCAR'S MOST IMPORTANT RICE AND FISH PRODUCTION AREA

P.L. Lammers^{1,2}, T. Richter^{1,2}, A. Rendigs², P.O. Waeber^{3,4} & J. Mantilla-Contreras^{1,2}

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Lake Alaotra is Madagascar's biggest wetland system with 20,000 ha open water body and 23,000 ha freshwater marshes. The lake and its marshes support several critically endangered and locally endemic species and are protected by the Ramsar Convention since 2003. Lake Alaotra also constitutes the biggest rice and freshwater fish supply for Madagascar. The local population, mainly fishermen and rice cultivators, depend entirely on the wetland system. Due to increasing human pressure, the Alaotra wetlands are continuously threatened by the conversion of marshland into rice fields, over-fishing and lake siltation caused by erosions of deforested hills. In addition, the invasion of the non-native water hyacinth (*Eichhornia crassipes*), which is fostered by high use of fertilizers and pesticides, might amplify the precarious changes of the ecological but also economic values in the region.

Although the impact of *E. crassipes* is well documented for many regions of the world, there is no study yet about the ecological effects of this species on the Lake Alaotra. Besides, the last comprehensive ecological survey is dated back almost 20 years. Since then the human population of the Alaotra region has grown from 109,000 to over 700,000 in the 2000s mainly due to economic immigration. This study assessed the current ecological status (for 2012/13), with special focus on the water hyacinth and its impact on natural lake vegetation and water quality. Our study compares water parameters such as conductivity, pH, temperature, oxygen and nutrient contents at three areas of the lake, which show high differences in marsh degradation (intact versus degraded). In addition, plant diversity, composition and structure of the lake shore marshes and the abundance of *E. crassipes* were assessed.

First results show a disturbed lakeshore plant composition at sites with high marsh utilization by the local communities. This observation is combined with an increased abundance of *E. crassipes* and a reduced abundance of native aquatic plants (e.g. *Nymphaea nouchali*). Water quality analysis reveals that oxygen levels are higher in regions with intact vegetation while the acidity levels are higher in degraded areas. Furthermore, nutrient levels of Lake Alaotra have increased over the past 20 years. Knowing that ecological predicament, the understanding of ecological trends at Alaotra is crucial for the conservation and sustainable management of the Alaotra wetlands.

O5 - IMPACT OF INVASIVE PLANT SPECIES ON THE HABITAT QUALITY OF THE ALAOTRAN GENTLE LEMUR (*HAPALEMUR ALAOTRENSIS*) AT LAKE ALAOTRA, MADAGASAR

J. Mantilla-Contreras^{1,2}, T. Richter^{1,2}, A. Rendigs², P.L. Lammers^{1,2}, L.M. Reibelt^{1,2}, T.F. Rakotoarisoa^{1,3} & P.O. Waeber^{3,4}

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The Alaotran gentle lemur (*Hapalemur alaotrensis*) represents the world-wide unique primate species which entirely lives in a wetland system. The species is only known from the Alaotra region in eastern Madagascar. The diet of this lemur species strongly depends on dominant naturally occurring fresh water plant species such as papyrus (*Cyperus madagascariensis*), reed (*Phragmites communis*), and *Echinochloa pyramidalis* and *Leersia hexandra*).

Currently, this year-round marshland living primate is facing extinction. The Alaotra region is of national importance for rice and fish production. Ongoing human immigration into the area and a growing resource need

have resulted in the degradation and loss of the natural marsh vegetation. Further problems include the invasion of non-native plant species such as water hyacinth (*Eichhornia crassipes* and *Salvinia spec.*). In this talk we will discuss how invasive plant species such as *E. crassipes* directly and indirectly influence the plant species composition of the lake shore and with that the habitat of *H. alaotrensis*.

Session W2 - Climate change and mitigation in coastal ecosystems

Chairs: **A. Garbutt¹ & J. Pétilion²**

¹*Centre of Ecology & Hydrology, Bangor, U.K.*, ²*University of Rennes, Rennes, France*

Coastal ecosystems are among the most valuable in the world but have for many centuries been subject to anthropogenic disturbance and the impacts of climate change. Whilst the impacts of management, land reclamation and flood defences have been well documented, less well known are the ecological responses to changing climate and rises in sea level. These include responses of biota such as altered phenology and the resulting effects on species interactions, the expansion or shift in plant and animal ranges, species resilience to climate change; and also responses of ecosystem processes and functions such as the reaction of carbon pools and nutrients to increasing CO₂ and warmer temperatures and the response of ecosystems to changes in sediment supply and inundation frequency. An understanding of these effects is fundamental to sustainable coastal ecosystem management and conservation in ecosystems likely to experience significant pressure from climate change. The interactions between these biological and physical processes are often complex and non-linear. The potential effects of climate change are exacerbated by predominantly linear habitats, usually with a fixed landward margin where society has historically been unwilling to accommodate environmental change. Increasingly, there is recognition that maintenance of existing coastal defence is no longer economically viable in some cases. In recent years the focus has moved toward managing coasts in a more dynamic way, protecting hinterland areas of high value whilst allowing natural coastal processes to proceed relatively unhindered elsewhere. Mitigation measures include the remobilisation of sand dunes, seagrass restoration and the managed realignment of coastal defences to create salt marsh and mudflat.

This session will bring together science on the potential impacts and responses of coastal ecosystems to climate change and on the attempts to mitigate for such changes. We welcome abstracts related to the biological and physical impacts of climate change and the ecological restoration of coastal ecosystems, especially those directly related to the conference theme.

O1 - A REVIEW OF THE STATE OF KNOWLEDGE OF CLIMATE CHANGE IMPACTS AND MITIGATION IN COASTAL ECOSYSTEMS

A. Garbutt¹

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(corresponding author: ag@ceh.ac.uk)

Coastal ecosystems have for many centuries been subject to anthropogenic disturbance and the impacts of climate change. Whilst the impacts of rising sea level on physical processes have been well described, less well known are the ecological responses to changing climate. These include altered phenology and the resulting effects on species interactions, the expansion or shift in plant and animal ranges, species resilience to climate change; and also responses of ecosystem processes and functions such as the reaction of carbon pools and nutrients to increasing CO₂ and warmer temperatures and the response of ecosystems to changes in sediment supply and inundation frequency. A general assessment of the literature will describe trends in research themes and review the current state of knowledge for saltmarsh ecosystems. Focus is given to ecological and functional responses to changing climate and mitigation. The distribution of article type (e.g. review, editorial, case study); what pressures are most commonly studied; the most common indicator variables used to detect change; and predicted ecological responses are described. We conclude by identifying knowledge gaps and make recommendations for future research in mitigation and climate change science for coastal ecosystems.

O2 - TRADE-OFFS IN ECOSYSTEM FUNCTIONS AND SERVICES OF COASTAL ECOSYSTEMS WITH RESPECT TO CLIMATE CHANGE AND COASTAL PROTECTION (EXAMPLE OF THE GERMAN BALTIC SEA)

A. Koch^{1,2} & J. Mantilla-Contreras²

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Coastal ecosystems are most endangered by rising sea level and increased storm flood events due to climate change and increased coastal protection. Additionally, changes in water level and climate directly affect vegetation performance. At the German Baltic Sea, two main vegetation types – brackish reeds and salt grasslands - are common along low-lying areas. Brackish reeds represent the natural vegetation type of those areas. However, in many areas reed beds have been replaced by salt grasslands, which have developed after decades of extensive grazing. In comparison to reed beds, salt grasslands have a high biodiversity and have therefore a high conservation value. For the maintainance of the salt grasslands, a continuation of extensive use is necessary.

In the context of climate change and rising sea level it is important to know which habitat – reed or salt grassland – might better withstand the changing conditions. Both vegetation types have advantages and disadvantages concerning the ecosystem functions and services and both are affected by climate change. If salt grasslands can withstand the rising sea level depends on the capability of salt grasslands to vertically grow with the sea level, the stress level of the plants, the size of the available area (natural and anthropogenic boundaries) and erosion intensity (reduction of the area).

In this regard, we will discuss the ecosystem functions and services of both habitats, the management possibilities in response to climate change and we will highlight the trade-offs between the two ecosystems and on which goals nature conservation should focus in the future.

O3 - EFFECTS OF REGIONAL CLIMATE CHANGE FOR MARSH VEGETATION ALONG THE WESER AND ELBE ESTUARIES

M. Heuner¹, U. Schröder², E. Fuchs¹ & E.M. Bauer²

¹German Federal Institute of Hydrology, U2-Ecological Interactions, Koblenz, Germany; ²German Federal Institute of Hydrology, U3-Vegetation Studies, Landscape Management, Koblenz, Germany
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Due to expected impacts of climate change on the hydrological regime of Federal Waterways we focus on an adapted floodplain management of German estuaries. Because of their consequences for bank protection and bank maintenance at waterways, it's necessary to assess climate change effects on marsh vegetation along German estuaries. If hydrological extreme events become more frequent and if the tidal range increases, bank protection may be degraded due a narrowing or fragmentation of reed belts. Our research questions are how stable and resilient are natural banks against hydro-mechanical stress like ship and wind waves and will natural bank habitats experience alteration in the future. To spatially assess the effects of regional climate change, we perform a sensitivity analysis with different river sediment supply and changing mean high water (MHW) by using distribution models of common macrophyte species along the estuarine part of the River Elbe and the River Weser. Assuming that sediment is available at any time and an equilibrium elevation between marsh surface and MHW is established in a short time period, modelling results reveal no essential future vegetation shift. Assuming a non adapted steady-state topography, a clear reduction of potential habitats of common reed as well as a considerable shift of mean high water line in comparison to the modelled reference state of vegetation distribution is noted. The results depict how important it is to consider topography alteration in the context of mean sea level rising.

Mitigating the effects of climate change on maintaining future multifunctionality of estuarine waterways needs, providing additional retention areas as well as riparian boundary strips of uncultivated land providing natural vegetation habitats are a must-have. Both will act as an effective and sustainable buffer against potentially increased hydrodynamic forces due to climate change induced hydrological changes.

O4 - SALT GRASSLANDS ALONG THE GERMAN AND POLISH BALTIC SEA COAST AND THE INFLUENCE OF WILD GRAZING ANIMALS

R. Pätsch¹, A. Piernik² & J. Mantilla-Contreras¹

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Salt grasslands are semi-natural habitats along the Baltic Sea coast which replace the natural common reed stands of low-lying areas. They have developed through extensive anthropo-zoogenic management since the 13th century. Today, they are characteristic landscape elements of the Baltic Sea coast and provide a habitat for a very specialized flora and fauna. Salt grasslands have a great importance for coastal protection as they function as a natural sea defence. Due to embankment of large areas and abandonment of the traditional management, salt grasslands have dramatically declined and the remaining fragments are endangered. While the impact of anthropogenic managed grazing is well studied, there are only a few studies about the influence of so called 'natural grazing'. This is especially of interest because in Poland, areas with salt grassland exist which never have been grazed by cattle and might have developed only because of natural grazing.

In this talk, an overview of different areas will be given, considering varying management and the different vegetation types found on salt grasslands along the German and Polish Baltic Sea coast. The occurring wild animals and their influence on salt grasslands and specific plant species will be presented. In conclusion, future prospects will be given which will include for example more specific studies on soil science as well as experiments under laboratory conditions that focus on (1) the phenomenon of the already mentioned non-managed salt grasslands and (2) on climate change and their influence on species distribution and condition.

O5 - LINKING SEDIMENT STRUCTURE, HYDROLOGICAL FUNCTIONING AND BIOGEOCHEMICAL CYCLING FOLLOWING DE-EMBANKMENT OF RESTORED COASTAL SALTMARSHES

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Saltmarsh restoration (managed realignment) undoubtedly provides environmental enhancement, with vegetation quickly re-establishing following the breach of sea walls and subsequent tidal inundation of previously defended areas. However, these environments have been 'disturbed' by previous land use and there is little understanding of the impacts of this disturbance on wider ecosystem functions and the quality and quantity of the biogeochemical ecosystem services provided by these restored environments.

This study examines physical sediment characteristics, sediment structure (using X-ray microtomography), sub-surface hydrology (using pressure transducers), and sediment and porewater geochemistry (major and trace elements, major anions) in sediment cores collected from undisturbed saltmarshes and those restored by de-embankment.

Sub-surface sediments in restored saltmarshes have lower organic matter content, lower moisture content and higher bulk density than undisturbed sites. Using X-ray tomography a clear horizon can be observed which separates relict agricultural soils at depth with less dense and structureless sediments deposited since de-embankment. Sub-surface hydrological response to tidal flooding was subdued in the restored compared to the undisturbed site, suggesting that porewater flow may be impeded and/or flow pathways differ in restored saltmarsh sediments.

The undisturbed saltmarsh displayed typical vertical geochemical sediment profiles. However, in the restored sites total Fe and Mn are elevated at depth indicating an absence of diagenetic cycling, whilst porewater sulphate and nitrate increased at depth suggesting that vertical solute transport is impeded in restored sites. In surface sediments, though total Hg concentrations are similar, Hg methylation rates are significantly higher than in the undisturbed saltmarsh suggesting that surface anoxia and poor drainage may result in increased mobilization of Hg.

These findings have implications for the wider biogeochemical ecosystem services offered by saltmarsh restoration and highlight the need for integrated understanding of physical and biogeochemical processes.

O6 - FUNCTIONAL TRAIT DIVERSITY ALONG ABIOTIC GRADIENTS AND ITS EFFECT ON ECOSYSTEM PROPERTIES IN WETLANDS

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Coastal areas at the North and Baltic Sea are likely to be highly affected by climate change and sea level rise. Within this framework we ask the question how altered abiotic factors affect functional diversity in a plant community and if and how ecosystem functions respond to this. Disentangling the factors driving functional diversity and its effect on ecosystem functions remains a major task in ecology. We address this question by investigating plant functional diversity within and between communities along gradients of salinity and water availability in coastal areas as well as a variety of ecosystem functions.

We expected low functional diversity at sites with high environmental stress (strong abiotic trait-based species sorting) and a higher functional diversity caused by biotic filtering at sites with lower levels of environmental stress. Furthermore we expected that biotic filtering could lead to convergence of traits in cases where one species outcompetes others. Rates of ecosystem processes were expected to increase with functional diversity due to complementarity of resource use, but the responses to be non-linear. In 200 plots situated in four areas along the North and the Baltic Sea we recorded abiotic factors and stressors (inundation, plant available soil water availability, soil water salinity, soil nutrients, disturbance, grazing intensity), plant species and trait composition (form- and mass-based traits), as well as ecosystem productivity and litter decompositions.

Our expectations regarding functional diversity were generally confirmed by the results. Yet, a strong functional convergence due to biotic filtering could also be recorded on intermediate stress levels. The results give insight into the functioning of North-western European coastal areas in regard to functional diversity and add to predicting the influence of climate change and land management change in this region.

O7 - SUCCESS OF MANAGED REALIGNMENTS FOR THE RESTORATION OF ARTHROPOD COMMUNITIES IN ESSEX (UK)

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Studying succession process and its related factors in salt marshes encompasses both fundamental (community structure) and applied (biodiversity conservation and restoration) issues [1]. Current managed realignment projects and sites where, in the past, large storm events led to breaches in embankments, created unique experimental conditions for such challenges by re-instating tidal inundation and salt-marsh development. We conducted a pair-matched approach using natural and recreated (either accidentally or managed) salt marshes and studied changes in invertebrate communities over time during a, synchronic, field experiment in 2005 (Essex, UK). Trophic guild was assigned to all invertebrates, and detailed analyses conducted on most abundant (amphipods, *Orchestia* sp., 9666 individuals) and diversified (spiders, 43 species) groups. A total of 27,180 invertebrates (almost all arthropods: 99 % of specimens) was collected in 2005. The conservation equivalency was achieved quickly (which was shown here with spider assemblages: [2]), but that did not translate into a complete functional equivalency. Indeed neither the salt-marsh trophic structure, nor the potential role of marine enrichment and fish nursery, estimated through the population abundance of amphipods, were achieved by managed realignments. We finally argue that the study of invertebrates brings information complementary to those brought by plants, and underlines that functional and conservation equivalency have to be assessed separately.

[1] Adam P., 1990. *Saltmarsh ecology*. Cambridge University Press, Cambridge.

[2] Pétilion J. & Garbutt A., 2008. Success of managed realignment for the restoration of salt-marsh biodiversity: preliminary results on ground-active spiders. *Journal of Arachnology*, 36: 388-393.

O8 - RESTORING ESTUARINE WETLANDS – ‘GOOD FOR THE ECOLOGY’ OR MERELY ‘GOOD FOR THE ECOLOGISTS’?

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The importance of ecological functions provided by intertidal areas and their benefits to society has recently been widely recognised. Wetland habitats worldwide are amongst the most productive and economically valuable yet there is increasing pressure on these habitats in the form of coastal development and coastal squeeze from relative sea level rise. This is coupled with growing concern over the associated loss of function and the resultant effect on society. Within Europe, managed realignment, as the re-engineering of coastline to produce natural defences, is increasingly being used as compensation for habitat loss, as mitigation for sea level rise and as flood defence hence getting the ‘triple wins’ for ecology, public safety and the economy. It is highly effective in creating wetland habitats although the habitats that have developed do not necessarily match those that have been lost and the success of the technique is very much open to debate. Assessment of ecological habitat and community development in these sites has primarily focused on structure rather than function and much of the analysis centres on simplistic measures of species richness, abundance and biomass with few studies assessing detailed community structure. The macrotidal and sedimentary Humber estuary (NE England) has 4 managed realignment sites, each with different role (compensation for land claim, mitigation against sea level rise, flood defence and compensation for flood defence works). The area is undergoing isostatic rebound and the adjoining coastline has rapid coastal erosion which creates extremely high turbidity within the estuary. This leads to rapid accretion in sheltered, enclosed intertidal areas, presenting a problem to habitat creation schemes. Here, we focus primarily on two of those sites (Paull Holme Strays and Alkborough Flats) and demonstrate the structural ecology and aspects of the functional ecology of the habitats and communities and the trajectories of their development. We demonstrate the success (or otherwise) of these sites in terms of habitat creation and mitigation for habitat loss against estuarine policy and environmental management.

O9 - IMPACT OF HUMAN DISTURBANCES ON THE DIET OF YOUNG FISH IN TIDAL SALT MARSHES

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Saltmarshes are known to be important nurseries for numerous fish species, but anthropic perturbations like invasive plants or grazing by large herbivores have frequently been reported to impact this main function (e.g. Laffaille et al. 2001, 2005). Using stable isotope analyses, we have explored the effect of contrasted dominant plant species from two sites (native vs. invasive species in both the Mont St. Michel bay and Seine estuary, France) on the structure of salt-marsh food web, including predatory young-of-the year fish. Surprisingly, whatever the site considered, the food web structure was not strongly different between invaded and non-invaded habitats. Conversely, a strong site effect was found with a clear mixing of marine (fish and marine preys) and terrestrial (arthropods) food webs in Seine estuary, whereas they remained segregated in the Mont Saint St Michel bay. The effects of other factors are discussed to explain those results, and notably the status of detritus feeders like *Orchestia gamarella*, known to be a main and abundant resource for fish in tidal salt marshes (Mantzouki et al. 2012).

*Laffaille, P., Lefeuvre, J.-C., Schricke, M.T., Feunteun, E. 2001. Feeding ecology of 0-group sea bass *Dicentrarchus labrax* in salt marshes of Mont-Saint-Michel bay (France). *Estuaries* 24, 116-125.*

*Laffaille, P., Pétilion, J., Parlier, E., Valéry, L., Ysnel, F., Radureau, A., Feunteun, E., Lefeuvre, J.-C. 2005. Does the invasive plant *Elymus athericus* modify fish diet in tidal salt marshes? *Estuarine, Coastal and Shelf Science* 65, 739-746.*

Mantzouki E., Ysnel F., Carpentier A., Pétilion J. 2012. Accuracy of pitfall traps for monitoring populations of the amphipod *Orchestia gammarella* (Pallas 1766) in a salt marsh. *Estuarine, Coastal and Shelf Science* 113, 314-316.

O10 - MAIN DRIVING FACTORS FOR SEACOAST VEGETATION IN SOUTHERN BALTIC

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Main driving factors for seacoast vegetation in southern Baltic were investigated to detect the most important potential endangers in environment in case of climate change. The research has been done on 13 selected stands along Baltic seacoast from surroundings of Greifswald in Germany through Poland to Tallinn in Estonia. The estuary and lagoon type of the seacoast were included. In each stand phytosociological relevés were taken to describe the vegetation and soil samples to characterize abiotic conditions. The following parameters were determined: the distance from the sea line, the type of use, soil moisture, organic matter, redox potential and EC, TDS, SAR, Na⁺, Ca²⁺, Mg²⁺ in saturated extract. TWINSpan method was used for vegetation classification. Canonical Correspondence Analysis were applied to analyze vegetation-environment relations. Statistical significance and relative importance of each environmental factor were assessed based on Monte Carlo Permutation test and forward selection procedure. Results demonstrate that six type of phytocenoses were present in the investigated stands: *Phragmites australis*-*Calystegia sepium* comm. (predominant in Polish seacoast), *Schoenoplectus tabernaemontani*-*Bolboschoenus maritimus* com., *Juncus gerardi* com., *Ranunculus sceleratus*-*Ranunculus trichophyllus* com. and unique on Baltic seacoast *Salicornia europaea* comm. (typical for Estonian Baltic coast). The highest soil salinity was noted in Estonia, what is opposite to described in literature gradient of water salinity in Baltic. For the vegetation differentiation the most important abiotic factors were total salinity, soil moisture and redox potential. Therefore it could be concluded that mostly changes in hydrological conditions after climate change would change the existing vegetation in southern Baltic coast.

P1 - ADAPTATION OF PLANTS TO ADVERSE ENVIRONMENTAL CONDITIONS

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Plants are exposed to many types of abiotic stress during their life cycle. Many morphological and physiological adaptations to water stress are under the control of the plant hormone abscisic acid (ABA). The phytohormone abscisic acid (ABA) plays a major role in regulating several developmental and physiological processes in the plant such as seed development and germination, and mediating the response of vegetative tissues to osmotic stress.

Plants increase endogenous ABA levels in response to drought and many drought-inducible genes are induced by exogenous application of ABA, indicating the role of the phytohormone in mediating drought responses at the transcriptional level. ABA regulated genes encode proteins that are thought to function, directly or indirectly, in protecting cells from dehydration.

Proteins that participate in stress tolerance are Rab (Responsive to ABA) proteins, LEA (late embryogenesis abundant) proteins, chaperones, aquaporins and ion channels, enzymes required for the biosynthesis of various compatible solutes, and detoxification enzymes. In *Arabidopsis*, more than half of the drought-inducible genes are also induced by high-salinity and/or ABA, suggesting the existence of a significant cross-talk among these responses. Another group of proteins are involved in ABA signalling cascades and gene expression regulators, among them: metabolic enzymes, protein kinases and phosphatases, and transcription factors. Here, we discuss recent advances in our understanding of abiotic stress adaptation mediated by specific changes in gene expression.

Session W3 - Future challenges for the conservation and restoration of river landscapes

Chairs: **E. Mosner¹ & M. Heuner¹**

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River landscapes such as floodplains or estuaries belong to the most diverse ecosystems on earth due to high levels of spatial and temporal heterogeneity. Moreover, they deliver a variety of valuable ecosystem services (e.g. biomass production, sediment stabilization, disturbance regulation, water purification and retention, etc.). During the last centuries river landscapes have undergone substantial changes as a result of human impacts such as land use change and river training. Today, these systems face additional threats such as climate change and invasive species. Hence, the conservation and restoration of such systems, especially on a regional scale, is quite a challenge given the different interests of economy, society, and nature conservation.

This session aims at presentations dealing with all kinds of aspects about the conservation and restoration of river landscape ecosystems, with a special focus on current challenges such as climate change, invasive species as well as social and economic pressures (e.g. flood protection, land use, shipping, etc.). Studies may address basic research questions, but preference will be given to presentations coping with clearly applied issues. Most welcome are contributions addressing these issues on a larger, i.e. regional scale, but also presentations targeting small scale approaches.

O1 - LIFE NATURE FOR FRESHWATER ECOSYSTEMS: EXAMPLES AND BEST PRACTICES ON THE RESTORATION OF RUNNING WATERS

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The LIFE Programme has been the European Union's funding instrument for the environment since its approval in 1992. It is composed of three strands (LIFE Nature and Biodiversity, LIFE Environment Policy and Governance and LIFE Information and Communication). Since its establishment 21 years ago, the LIFE Nature and Biodiversity component (formerly LIFE Nature), has co-financed a total of 1348 projects, providing some € 1.2 billion, and mobilising a further €1.2 billion in other public and private contributions. This continuous source of targeted financing has radically changed the capacity of many countries and regions to care for and manage Natura 2000 sites.

LIFE projects actions are varied and can encompass the development of management plans and other policy documents, support for the enlargement of the Natura 2000 network, improving knowledge of species and habitats, direct conservation actions, capacity building and awareness raising. The results of the first assessment of the conservation status of species and habitats (Article 17 report), which was published in 2010, highlight the importance of LIFE as the sole source of funding for the conservation, restoration and management of certain species and habitats at EU level. Most LIFE projects targeting habitat restoration have resulted in the sites concerned achieving favourable conservation status.

Freshwater habitats, with more than 300 projects co-financed, are one of the habitat types that have been most often targeted by LIFE (together with forests and grasslands). Some examples of projects actions on freshwater habitats include: improving water quality; managing water levels; restoring river ecosystems; improving habitats of freshwater species (such as the water pearl mussels and riverine fishes, plants and birds); controlling and eradicating invasive alien species; managing river basins and Natura 2000 sites; enhancing habitat connectivity, restoring floodplains, re-meandering rivers and involving relevant stakeholders (such as farmers, anglers, shipping companies, etc.).

This communication will present some examples and best practices from successful LIFE Nature projects targeting freshwater ecosystems, and particularly running waters, with the aim to contribute to the active dissemination of the results.

O2 - IS RESTORATION OF WILLOW SOFTWOOD FORESTS IN TIDAL WETLANDS POSSIBLE IN TIMES OF SEA LEVEL RISE?

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Willows had been common components of river flood plain softwood forests in temperate zones. Today, only fragmented willow populations are remaining in along the shores of the densely populated European estuaries due to land use changes, human alteration in river morphology and an overall reduction of tidal flood plains. Furthermore, projected climatic changes will lead to changes in estuarine hydrology. Projected changes in precipitation pattern are expected to lead to earlier river discharge maxima and to pronounced minimum discharges. Further, sea level rise will increase the frequency, height and duration of inundation in tidal wetlands along temperate estuaries.

How will willows in tidal wetlands respond to these predicted changes in hydrology?

In Europe, *Salix alba* and *Salix viminalis* are characteristic willow species of softwood forests in riverine and estuarine flood plains. Their ability to tolerate high water levels during long time periods is well studied. However, little is known about their tolerance of periodically changing water levels corresponding to predicted sea level rise. Willow softwood forests have a great importance for biodiversity and ecosystem services: They are protected as priority habitats by the European Habitat Directive, and a good conservation status has to be maintained or, if necessary, to be restored. Furthermore, flood plain willows contribute to flood control with abilities to attenuate waves and elevate flood plain surfaces. With regard to restoration and sustainable use of these habitats, we investigated the tolerance of *Salix alba* and *Salix viminalis* to predicted increasing tidal flooding heights and duration.

First, we recorded the distribution of both willow species along the estuarine Elbe stretch. Second, we conducted a flooding experiment on cuttings of both species, taken from individuals from a freshwater and an oligohaline site. Here, cuttings were exposed in tidal basins to different tidal flooding regimes, which correspond to predicted changes in flooding regimes caused by sea level rise. First results indicate both species tolerance up to 0.8 m daily flooding height.

We conclude that willow species seem to be able to keep pace with the effects of moderate climatic change scenarios due to their tolerance to predicted increasing tidal ranges. The results of our study can be used as a scientific basis for the restoration of willow softwood forests in tidal wetlands in times of sea level rise. Restoration would contribute to both, the required conservation of biodiversity and to the delivery of ecosystem services in estuarine environments.

O3 - CLIMATE CHANGE AND FLOODPLAIN VEGETATION - POTENTIAL EFFECTS OF HYDROLOGIC ALTERATIONS ON THE HABITAT AVAILABILITY OF RIPARIAN PLANT SPECIES

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River floodplains belong to the most diverse ecosystems in Europe which is emphasized by their conservation status given by the NATURA 2000 network. Additionally, the EU Water Framework Directive (2000/60/EC), which demands the good ecological status of rivers, conveys the important role of the riparian zones for the functioning of the river ecosystem. However, floodplains also belong to the most endangered ecosystems due to anthropogenic impacts such as river regulation, river training, and land use change which led to an enormous loss and transformation of floodplain areas during the last centuries.

Climate change poses a further threat to floodplains and their characteristic vegetation types since hydrologic alterations of rivers and the adjacent floodplains are expected as a consequence of changes in temperature and precipitation patterns and therewith run-off in the catchments.

This study aimed at evaluating the potential effects of climate change induced hydrologic alterations on the habitat availability of characteristic floodplain plant species along the Rhine River for two future periods (2021-2050: near future, 2071-2100: far future). Therefore habitat distribution was modeled on the basis of species distribution data as well as environmental information such as hydrologic data and land use under current and potential future conditions. Several projections of hydrologic input variables were calculated based on a combination of different global climate models, regional climate models, a hydrological as well as a hydraulic model. These data built the input information to compute future habitat availability which was compared to the habitat distribution of the reference period to assess potential changes on a regional scale.

Results revealed no uniform changes of habitat availability for the species of different vegetation types along the flooding gradient. Rather, magnitude and direction of impact were dependent on the distinct response patterns of species to the hydrologic gradients, the spatial structure of the target regions as well as the climate change projection used. Overall, a large variability between species (within and between vegetation types), regions, and projections regarding future habitat availability could be observed. Habitat losses were mostly larger than habitat gains, resulting in an overall loss of habitat for the majority of projections for the different species. Besides, species' habitat availability was projected to be larger in the near future in comparison to the far future, which is mainly attributable to lower average water levels in the far future compared to the near future. To assess the minimum habitat area available given the variety of potential future conditions all projections were intersected with each other and quantification revealed that for most of the species projections overlapped to a large extent. This is an important prerequisite for an effective conservation management considering the large uncertainty of potential future conditions projected.

O4 - EFFECTS OF REDUCED PRECIPITATION ON THE FODDER QUALITY OF FLOODPLAIN MEADOWS ALONG THE ELBE AND RHINE RIVERS

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Flood meadows along large rivers offer suitable habitats for many rare plant species and are of great conservation value. Floodplains are hydrologically dynamic ecosystems, i.e. generally flooded in winter and dry during summer. Dry periods may increase due to reduced summer precipitation as projected for Germany by climate change scenarios. Further, floodplain meadows depend on low-intensity but regular land-use. As best practice, mowing twice a year without the use of fertilizer is recommended. Already today, it is of nature conservation concern how the biomass of these non-intensively managed meadows can be incorporated in agricultural systems. However, against the background of climate change the question arises, how the quality of the fodder might change and whether its usability will be more difficult in future.

From 2009 to 2013 we conduct a field experiment in floodplain meadows along the Elbe (from 2009-2011) and the Rhine (2011-2013) to investigate the effects of reduced summer precipitation on the quality of the harvested fodder. We reduced summer precipitation by 25% using rainout shelters. As response variables we measured the amount of biomass, its contents of nitrogen, carbon, phosphorus, potassium, crude protein, crude fibre, energy, and fructan. Preliminary results indicate that biomass production is not affected by the experimental treatment. Further results will be presented and discussed.

These experiments took and take place in the framework of the projects KLIMZUG-NORD (Elbe) and KLIWAS (Rhine). The goal of the subprojects presented here is to develop management strategies for a sustainable use of species rich floodplain meadows under changing climatic conditions.

P1 - DIFFERENCES AND CHANGES IN THE OPEN LANDSCAPE HABITATS OF THE VISTULA RIVER VALLEY

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Large river valleys have often been researched in observations of landscape vegetation diversity. The vegetation of river valleys shows dramatically the heterogeneity of and transformations in environmental conditions. Characteristic are enormous dynamics – the ability to revive and adapt to changing habitat conditions. There are neighbouring plant communities at different succession stages: pioneering and developed, progressive and regressive, initial and secondary. What is more, various human activities result in an impressive array of communities at different levels of anthropogenic transformation: natural (forests and shrubs), semi-natural (meadows, dry grasslands, rushes) and synanthropic communities (segetal and ruderal). A significant share of spontaneous vegetation communities is another distinctive feature of river valleys, especially of floodplain zones.

The great typological and spatial diversity of vegetation resulting from habitat conditions and human activities makes the Vistula valley an example of the special natural system. This is a system of very regular spatial distribution of vegetation types. The riverbed is the main factor determining this distribution. Fluvial processes form habitats at present as they did in the past. The nature and structure of vegetation are also influenced by anthropogenic factors, mainly agricultural activities, embankments and hydro-engineering constructions.

The research sought to indicate differences in the structure and vegetation composition along the Vistula river valley and changes in the nature of open landscape habitats within 50-year period. The study areas are located in the selected parts of the middle and the lower river valley. The study was based on the analysis of aerial photographs and vegetation maps. The analysis of changes determined the general trends of the natural environmental transformation and helped to indicate areas that should be protected.

Session G1 - Conservation and restoration of grassland biodiversity at multiple scales

Chairs: **B. Tóthmérész¹, P. Török¹ & O. Valkó¹**

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Grasslands, hosting a diverse and unique flora and fauna are vital landscape elements throughout Europe. Sustaining grassland biodiversity is a key element for biodiversity conservation, especially in agricultural landscapes. In the last century following agricultural intensification both the area and connectivity of grasslands have been decreased dramatically. Beside of area loss and fragmentation in Europe grassland biodiversity (richness and abundance of characteristic grassland species) became threatened by agricultural intensification (increased use of mineral fertilizers and pesticides) or by other forms of overuse (e.g. overgrazing, over-seeding by commercial grasses or energy grass). In the Eastern part of Europe especially after the collapse of state-run collectives agricultural lands were privatized. Because of the insufficient funds of new land owners the number of livestock decreased and many types of grassland, especially in the mountain areas were abandoned. The mentioned land-use changes led to the decrease of grassland biodiversity. The recognition of the high biodiversity value and threatened status of European grasslands also has resulted in the development of projects targeting the conservation and restoration of grassland biodiversity. Developing improved strategies for conservation and to understand the joint effects of local management and landscape scale factors sustaining grassland biodiversity are essential tasks.

The overall aim of the session is to explain patterns, recovery and sustainability of grassland biodiversity across multiple taxa (invertebrates, vertebrates, bryophytes, lichens, vascular plants, fungi) and scales (local, habitat and landscape-level effects). Contributions analyzing patterns and processes concerning conservation and restoration of grassland biodiversity are highly welcome.

O1 - LOCAL AND LANDSCAPE EFFECTS ON PLANT AND ORTHOPTERA DIVERSITY IN SEMI-NATURAL GRASSLANDS IN SOUTHERN TRANSYLVANIA, ROMANIA

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Semi-natural grasslands are an important and often very species-rich element of agricultural systems in Europe. However, large areas of this habitat have already been lost, and remaining fragments are being degraded by intensification and abandonment of farmland. Whilst the impacts on grassland diversity of local intensification or abandonment are well studied, there is a relatively low level of understanding about the potential effects of management changes in the surrounding landscape. Furthermore, most existing studies on landscape effects have been carried out in highly modified and fragmented landscapes of Western Europe, which can be expected to differ in their ecological processes from more extensively managed and species-rich landscapes. This study focuses on the region of Southern Transylvania (Romania) in Eastern Europe, an area with widespread species-rich pastures and meadows in extensively managed landscapes with large proportions of semi-natural elements. It explores the relationships between plot-level diversity of two important grassland taxonomic groups, vascular plants and Orthoptera, and local and landscape factors in extensively used pastures along a gradient of landscape heterogeneity. Whilst local factors such as soil pH and slope had the greatest influence on the vegetation, significant effects of landscape composition were also found, including a positive effect of landscape heterogeneity within a 2 km radius on plant species richness. Orthoptera also responded significantly to landscape factors, increasing in abundance of generalist, but not specialist, species with proportion of grassland in the landscape. The composition of the surrounding landscape thus exerts different effects on different taxonomic and functional groups of species. The findings demonstrate that grassland biodiversity conservation approaches that focus on the field scale, as is frequently the case e.g. with agri-environment scheme measures, are insufficient even for large species-rich grasslands.

O2 - EFFECTS OF SURROUNDINGS AND ENVIRONMENTAL VARIABLES ON ALKALI GRASSLAND RECOVERY IN GRASSLAND RESTORATION PROJECTS

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Alkali grasslands in East-Hungary are priority habitats of the Natura 2000 network and are one of the best preserved grassland ecosystems in Europe. Alkali grasslands were fragmented by the establishment of drainage canal systems in the 70's and 80's in the study region. These canals also formed barriers for grazing animals. Thus, grassland management by livestock grazing was not feasible in grassland fragments surrounded by canals. To mitigate these effects, landscape-scale restoration projects were started on 4000 hectares to restore grasslands, eliminate canals by soil-filling and to improve landscape connectivity. We studied spontaneous recovery of alkali grassland vegetation in a multi-site study with space for time substitution. We studied grasslands on former canals restored by soil-filling between 2003 and 2011 in 8 "puszta" regions of the Hortobágy National Park. We recorded the percentage cover of vascular plants in altogether 558 plots in 2012. Species composition of alkali grasslands is generally influenced by soil salinity and micro-relief; thus, we studied (i) cross-section micro-relief profile in soil-filled canals and (ii) soil parameters (salinity, pH and soil water content). We found that vegetation of soil-filled canals became similar to the surrounding grasslands within 5-9 years independently of the surrounding grassland types. Grassland recovery on soil-filled canals was fast, because (i) they are surrounded by target grasslands and (ii) have a low perimeter/surface ratio, which enables the fast immigration of target species from the surroundings. Micro-relief profile significantly influenced grassland recovery: even soil surface favoured the recovery of vegetation similar to the surrounding grasslands. Rugged soil surface favoured the establishment of noxious weedy thistles (like *Cirsium* and *Carduus* species) hampering restoration success. We found that the number and cover of weed species correlated negatively with soil salinity. Thus, grassland recovery was faster in sites with high soil salinity. We found that grassland recovery on soil-filled canals depended largely on micro-relief and soil properties, while surrounding grassland type and time since soil-filling had only a subordinate role. To facilitate restoration success precise soil smoothing is essential, even in those sites, which are surrounded by target grasslands. Our results suggest that in case of alkali grasslands only a few centimetres unevenness in the created open soil surface can hamper restoration success.

O3 - DISTURBANCE REGIME AND DIVERSITY IN SEMIDRY GRASSLANDS CAUSED BY WILD UNGULATES

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Most of semi-dry grassland habitats in the Central Europe existed under the pressure of extensive livestock grazing in last centuries. The abandonment of agricultural landscape in the last few decades leads to lose of these vegetation types due to secondary succession. However, domestic animals are partly being replaced by wild ungulates, which provide the main part of disturbance regime in these endangered biotopes. Our study site is located in the military area Hradiště in Doupovské hory Mts. (Western Czech Republic, Central Europe). In comparison with the rest of Czech Republic, there is very low anthropogenic activity in the large buffer zone around the training ground. Since abandonment in 1953 secondary succession runs there from agricultural landscape to mosaic of secondary forests and shrub-land. Open enclaves with semidry grassland (*Festuco-Brometea*) still remain among the shrubs. The system hosts large population of wild ungulates (*Cervus elaphus*, *Cervus nippon*, *Capreolus capreolus*, *Sus scrofa*). Their impact on vegetation is a combined influence of grazing, browsing and rooting.

Open grassland enclaves, which are the main subject of this research, are dominated by *Brachypodium pinnatum* – a highly competitive grass species. The main factor causing disturbance regime in this vegetation seems to be wild boar (*Sus scrofa*). Small scale soil disturbances are occurring in the vegetation, opening space for less competitive species. We are trying to find out how these disturbances influence the dynamic and diversity of the

grasslands. In a field experiment established in 2007 we compared 30 artificial 1 × 1 m soil disturbances with undisturbed control plots and we annually phytocenologically monitored the succession.

Our results suggest that rooting increased both alpha and beta diversity which remained high at least 4 years after the disturbance. Vegetation on disturb patches could be classified more like *Hyperico perforati-Scleranthion perennis*. Essential factor in this system is frequency and dynamic of the phenomenon. So we repeatedly mapped natural disturbances occurring in our study site for 5 years. We modelled the diversity - disturbance frequency relationship with experimental vegetation data. The model suggested that the highest level of diversity would be associated with higher frequency of disturbances than is currently present in the studied system. Disturbance regime caused mainly by wild boars thus increases spatial heterogeneity and species diversity on enclaves of semidry grasslands and supports the mosaic vegetation structure of different succession stages and allows occurrence of otherwise rare open vegetation types. This is, however, only one of the effects that interact. There are also factors like grazing and browsing by boars and other ungulates that are acting on different spatial and temporal scales. The final landscape is a result of more complex processes, which are and will be also the subject of our interest.

O4 - ESTABLISHMENT SUCCESS IN A SEEDING EXPERIMENT IN GRASSLANDS OF DIFFERENT LAND USE

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Dispersal- and seed limitation can limit local species richness, especially in grasslands with transient seed banks. Understanding the factors influencing these processes is important to understand the factors limiting diversity in communities and also for restoration ecologists who want to increase local diversity. Dispersal limitation might be reduced in diverse communities because fewer empty niches exist or it could be higher if colonizing species are facilitated. Isolated grasslands would be expected to be more dispersal limited than connected ones, whilst fewer opportunities for establishment might exist in intensively managed grasslands. We tested for dispersal limitation by adding seeds of around 70 species from the local species pool to 85 grasslands in two regions in Germany. Grasslands differed in land use, soil conditions, productivity and resident species richness. In addition to adding novel species, not present in the grassland, in another treatment we added species already present on the plots to correct for seed mass (seed limitation) effects.

We found evidence for dispersal limitation because addition of novel species increased diversity in all three study years. In 2012, four years after sowing, species richness was up to 30% higher where novel species had been sown, compared to control plots. Resident species number was the most important factor affecting establishment success: more species recruited in species rich plots. This might indicate that diverse communities facilitate the establishment of novel species. A high abundance of bryophytes and a high root biomass also facilitated establishment. Dispersal limitation was also greater in isolated grasslands: more species successfully recruited in those plots with a lower percentage of grassland within a 1.5 km radius. Establishment was reduced in plots with high land use intensity, either because few species in the species pool were adapted to these conditions or because light competition was stronger in more intensively managed grasslands, and in plots with very high levels of disturbance, measured as cover of bare soil. We also found evidence that experimentally increasing species richness increased biomass production, which was 5% higher on plots where novel species were sown. We found no evidence for seed limitation: treatments with resident species sown on the plot did not have increased diversity and biomass. Our results show that diverse communities may not in fact be saturated with species and have implications for restoration efforts, which may be more challenging on species poor sites.

O5 - PASTORAL PRACTICES FOR THE RESTORATION OF SUB-ALPINE OPEN HABITATS: SHORT-TERM EFFECTS ON VEGETATION AND DUNG BEETLES

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Throughout the last decades, pastoral abandonment has produced deep landscape and ecological changes in the Western Italian Alps. In particular, the reduction of grazing has led to an extensive tree and shrub-encroachment of sub-alpine semi-natural grasslands, which represents a threat to alpine biodiversity, as the preservation of many plant and animal species is strongly dependent on the maintenance of these open habitats. In this study, two different pastoral practices were performed to restore shrub-encroached open habitats and short-term effects on vegetation and key ecological groups, the dung beetles, were assessed. The practices were the strategic placement of mineral mix supplements (MMS) to attract cattle into traditionally underused areas and the arrangement of temporary night camp areas (TNCA) over shrub-encroached vegetation patches. Practices were carried out during the summer 2011 in eight treatment sites (4 MMS and 4 TNCA) and for each treatment site a paired control site was identified. Vegetation surveys using vertical point-quadrat method and sward stick method and dung beetle sampling using dung baited pitfall traps were performed during the summer 2011 and 2012. In 2012, a reduction in shrub cover and an increase in bare ground cover around MMS sites were detected. A more intense restoration effect was detected within TNCA, as an increase in forage pastoral value, cover and height of the herbaceous layer were also detected. Immediately after treatment, changes in dung beetle diversity (total abundance, species richness, Shannon diversity, taxonomic and functional diversity) showed a limited disturbance effect caused by restoration practices. In contrast, the effect on dung beetles reversed one year later, changing from slightly detrimental to beneficial. Both at MMS and TNCA sites, dung beetle diversity significantly increased. Moreover, Multivariate Regression Trees analysis and associated Indicator Value showed that some ecologically relevant dung beetle species preferred areas deprived of shrub vegetation. Consequently, we suggest that the increase of open habitats can produce an increase in dung beetle diversity and that dung beetle community may positively influence the restoration of grassland vegetation with a “backward feedback”. Both MMS and TNCA appear to be sustainable practices for the restoration of open habitats, as they are low cost and they can be easily carried out on rugged alpine locations. Short-term effects produced are worth of mention in a framework of ecosystem functionality, considering that dung beetles are one of the main mediators of nutrient redistribution in soil and are therefore responsible for the ecosystem functions of sub-alpine grasslands.

O6 - BIOMASS- PLANT SPECIES RICHNESS RELATIONSHIP IN ALKALI GRASSLANDS ALONG A LONG PRODUCTIVITY GRADIENT

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Several mechanisms were suggested to explain the unimodal relationship between biomass production and species richness. However separated analyses of total biomass components and species strategies in relation to plant species richness in grasslands are still needed. We provided a detailed analysis of the relationship between major biomass components (total biomass, green biomass and litter), plant strategies and species richness in eight types of alkali and loess grasslands. We detected a unimodal relationship between total biomass and species richness. We detected a saturation curve for the relative proportion in green biomass for competitors, and a hyperbolic curve for stress-tolerators in relation to total biomass. Low proportion of ruderals was detected at both low and high biomass levels, possibly explained by establishment limitation via high levels of stress and microsite limitation. Compared to former studies, we detected negative litter effect at lower litter scores (even at 400 g/m²). Our findings suggest the importance of abiotic stress in determining species richness at low productivity and the increasing role of biotic interactions with increasing productivity. We found that litter shapes the change of species richness along the whole biomass gradient, while competition plays a crucial role only at higher biomass scores.

O7 - NDVI CAN PREDICT SPECIES RICHNESS AND ABUNDANCE OF GROUND BEETLES IN TEMPERATE FLOODPLAINS

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Remotely sensed data are frequently employed for monitoring vegetation and for estimating herbivore diversity. Their use for predicting predator arthropod species abundance and richness has also been investigated with success for ants and beetles in forests using NDVI and for beetles in mountain forests using LiDAR data. We investigated whether NDVI, derived from multispectral SPOT imagery could predict abundance and species richness of ground active spiders and ground beetles in a new ecological context, the floodplain meadows of the Loire River in Western Europe. Using pitfall traps we collected carabids and spiders in the field.

NDVI best explained species assemblages of both groups (multivariate analyses), but was strongly related to activity-density and species richness for ground beetles only. Relationships between NDVI and spider assemblage patterns were either non-significant or weak. We demonstrated that NDVI can help to predict the abundance and richness of carabid species in a temperate floodplain, and has potential as a low cost method for mapping arthropod assemblages at large spatial scales. Our approach provides a tool which contributes to biodiversity assessment at large spatial scales. It can also contribute to the prioritization of conservation areas and early change detection, as carabids are keystone indicators.

O8 - IMPACT OF BURNING, CUTTING AND GRAZING ON GROUND-DWELLING ARTHROPODS FROM GRASSLANDS AND SALT MEADOWS OF BRITTANY AND NORMANDY (WESTERN FRANCE)

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In this study, we aimed at assessing the efficiency of different management practises on two bio-indicator groups of macro-arthropods, spider (Araneae; [1]) and ground beetles (Coleoptera Carabidae; [2]). Burning, cutting, cattle, horse and sheep grazing were studied by comparing managed and non-managed parcels, sampled by pitfall trapping during 2002 and 2007, in different sites of Brittany and Normandy (NW France). Cutting and grazing, by opening soil and vegetation structures, enhanced the abundances of some stenotopic species of spiders and ground beetles ([3]). Nevertheless, sheep grazing appeared to be too intensive (reduction of spider species richness: [4]). Burning had overall a negative impact on spider assemblages. The used of different different community-level metrics (rarity and specialisation: [5]) on spiders also revealed that specialist species are not congruent with rare species, which may lead to a dilemma in terms of nature conservation. Those results will finally be compared to the conclusions of recent review works (e.g. [6] and [7]).

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O9 - EFFECTS OF IRRIGATION AND LAND USE ABANDONMENT ON THE BIODIVERSITY OF MOUNTAIN HAY MEADOWS IN THE VALAIS, SWITZERLAND

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Traditional management practices are important for the conservation of the biodiversity of semi-natural grasslands including species-rich hay meadows. In the Valais, Switzerland, hay meadows have to be irrigated in order to secure hay production owing to the dry climatic conditions in this region. However, the rationalization and modernization of agricultural practices during the 20th century led to the decline of agricultural activity in the mountain areas of this region. While numerous studies investigated the effects of land use abandonment, this is the first study to examine the combined effects of irrigation and management abandonment on the biodiversity of species-rich hay meadows. We compared the diversity and species composition of plants and gastropods among three serial stages of succession: five hay meadows, five early abandoned meadows and five young forests (15–30 years). We also assessed whether meadow abandonment leads to a loss of characteristic open-land species and to a shift in functional traits of plants and gastropods. The study showed that the combined effects of land use and irrigation abandonment led to a decrease in soil moisture and soil nitrogen content. The three succession stages did not differ in plant species richness, but there was a clear differentiation among the stages in terms of plant species composition. Gastropod species richness increased with ongoing succession and species composition of hay meadows clearly differed from the other two succession stages. Furthermore, for plants we observed a decrease in the proportion of characteristic grassland species with ongoing succession, while the proportion of forest species increased. The proportion of generalists increased from hay meadows to abandoned meadows, but did not differ between abandoned meadows and forests. For gastropods, the proportion of open-land species decreased from hay meadows to abandoned meadows and forests, while the proportion of generalists increased at the same time. Finally, meadow abandonment affected some functional traits of plants and gastropods. Meadow abandonment led to a shift in the type of reproduction of plants and favored late seed shedding species. Furthermore, plant height of forb species increased with ongoing succession. Gastropod species of abandoned meadows and forest sites were taller and reached sexual maturity at a later age than species of hay meadows. In conclusion, these results show that meadow abandonment has an impact on biodiversity after a relatively short period since management stopped. Therefore, meadow irrigation and the application of traditional management practices still existing in the study region are important to maintain the characteristic species-rich hay meadows of the Valais.

O10 - FORMALIZED CLASSIFICATION OF MEADOWS COMMUNITIES OF MOLINIO-ARRHENATHERETEA CLASS IN POLAND: NEW INSIGHT INTO DIFFERENTIATION AND NATURE CONSERVATION PROBLEMS

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Phytosociological studies on meadow vegetation have a long tradition in Poland. First papers describing meadows communities were published at the beginning of 20th century. During many years, hundreds of relevés were published mostly in regional papers. The comprehensive classification of Molinio-Arrhenatheretea class based on large data set was not performed in Poland so far. Until now, vegetation of Molinio-Arrhenatheretea class was described in accordance to traditional expert-based classification using characteristic species indicated in standard syntaxonomical overviews.

Since 2007, relevés of all vegetation types from Poland have been systematically entered to Polish Vegetation Database. Relevés stored in the database are describing meadow and deciduous forest communities, as well as crop fields, pine forests, wetlands, saum communities and xerothermic grasslands. Molinio-Arrhenatheretea class is one of the most represented syntaxa.

The objectives of the present study were (1) to conduct a formalized phytosociological classification of meadow vegetation in Poland, (2) to determine diagnostic and constant species, (3) to determine a distribution of distinguished syntaxa, (4) to determine their conservation status, (5) and to compare classification of meadow vegetation in Poland with classifications carried out in other European countries.

A phytosociological classification of Molinio-Arrhenatheretea class was carried out using the Braun-Blanquet approach. It is based on the formalized and supervised Cocktail classification method and expert system. The definitions of associations were created by combinations of sociological species groups using logical operators. In total, 42076 relevés were used from which 2965 relevés were assigned to Molinio-Arrhenatheretea class. In the result, 37 associations were distinguished belonging to the following alliances: Arrhenatherion, Polygono-Trisetion, Cynosurion, Molinion, Juncion effusii, Cnidion (Deschampsion) and Calthion. Ecology, diagnostic and constant species, as well as distribution of distinguished syntaxa were described. Conservation status of

distinguished syntaxa was also established with special attention to Natura 2000 habitats and meadows managed under agri-environment schemes.

Differentiation of Molinio-Arrhenatheretea class in Poland shows high similarity of higher syntaxa to these distinguished in other Central European countries. However, regional differences were found, especially in relevance to species groups. Additionally, the analysis revealed a new association that were not mentioned from the territory of Poland.

O11 - CEASED POST-RESTORATION MANAGEMENT BY MOWING LEADS TO FAST DEGRADATION OF RESTORED GRASSLANDS: A FIELD STUDY FROM HUNGARY

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Sowing low-diversity seed mixtures is a promising grassland restoration measure which can lead to the rapid development of grasslands characterized by perennial grasses even in a few years. However, after the formation of this grassland vegetation, restoration is not completed successfully, because for the sustainability of grassland biodiversity, regular post-restoration management is needed. Several studies stressed the importance of post-restoration management, but only a few of them concerns with the direct effects of mowing or abandonment on restored grasslands. We studied the effects of cessation of mowing on restored grasslands and asked the following study questions: (i) What are the effects of abandonment on the vegetation structure and diversity of restored grasslands? (ii) What are the effects of abandonment on sown grasses, target species and undesirable species? (iii) Is yearly mowing an appropriate management for the maintenance of restored grasslands? We studied 7 restored grasslands (former croplands sown by low-diversity seed mixtures in 2005) in Hortobágy National Park, East-Hungary. In each restored grassland, we designated two blocks: one of them mowing was ceased in the 4th year after sowing and the other one was mown continuously till now. We studied the changes in the percentage cover of vascular plants and biomass (green biomass and litter). The results of general linear model show that in abandoned blocks the amount of litter increased, while the diversity, the total vegetation cover and the cover of sown grasses decreased compared to the mown blocks. The cover of undesirable perennial species was significantly higher in abandoned blocks than in mown ones. Mown blocks remained more similar to natural grasslands than the abandoned ones. Regular mowing has a crucial importance in sustaining vegetation structure of restored grasslands, because without mowing the degradation is very likely and the expansion of noxious undesirable species is also typical. Thus, it is crucial to ensure to sustain a post-restoration management in restoration projects. Besides that regular mowing can maintain a favorable stage of restored grasslands, however, it is often not enough to reach further restoration goals. Further management options, like extensive grazing or hay transfer could be necessary to eliminate microsite and propagule limitation, and to facilitate the establishment of target species in the restored grasslands.

O12 - EXPANSION OF *CALAMAGROSTIS EPIGEJOS* IN SANDY GRASSLANDS OF THE MIDDLE ELBE VALLEY - EFFECT ON BIODIVERSITY OF FLORA AND GRASSHOPPERS AND EFFECTIVENESS OF MANAGEMENT METHODS

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Calamagrostis epigejos is a native tall grass, which in recent decades has tremendously spread in many semi-natural habitats all over Central Europe, for reasons not fully understood. When invading plant communities this mostly happens through lateral spread of large polycormons, i.e. effectively single genetic individuals consisting of thousands of shoots connected belowground by rhizomes. The consequence are large monodominant stands of *Calamagrostis*, in which due to the high and dense growth of this species and the accumulation of its poorly decomposable litter only few other plant species can survive. In our study we aimed at quantifying the speed of

expansion of *Calamagrostis* in valuable sandy dry grasslands of the Middle Elbe Valley over a 5-yr period, the effect of this process on diversity of vascular plants, bryophytes, lichens and grasshoppers and the effectiveness of several possible management methods. We found that over this period, the radial expansion of six different polycormons ranged from less than 1 m to nearly 8 m. On 100 m² an increase of *Calamagrostis* cover from 0 to 90% led to a decrease of average plant species richness (including bryophytes and lichens) from 33 to only 9, while the decrease of typical dry grassland species was even more dramatic, from 14 to 1 (–91%). Regarding the management treatments, two and four times mowing per year were most effective in reducing *Calamagrostis* cover on the medium term and better than mowing only once a year or ploughing at the beginning of the period, while intensive sheep grazing was even worse than the control. The pattern was consistent when considering the positive effect on 1-m² plant species diversity (all taxa, dry grassland taxa), while red-listed species did not benefit from ploughing, but from intensive grazing. In the case of grasshoppers, species richness was hardly affected by the treatments, but the number of typical dry grassland and of red-listed taxa was highest under intensive mowing (2x or 4x a year). We conclude that *Calamagrostis* is indeed a serious threat to the biodiversity and conservation value of sandy grasslands, while after five years even the most intensive management method was not able to get rid of *Calamagrostis* completely and to reach the floristic status of an uninvaded grassland.

O13 - FIRE AS AN ALTERNATIVE MANAGEMENT TOOL – ADAPTATION OF NORTH-AMERICAN GRASSLAND BURNING PRACTICES TO EUROPEAN GRASSLAND CONSERVATION

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In historical times fire had an essential role in maintaining biodiversity of grassland habitats and landscape heterogeneity. Instead of that, nowadays burning as a management tool is rarely applied in European grasslands while prescribed burning is an integral part of the North-American grassland conservation practice. According to the North-American experiences prescribed burning can be a vital alternative solution for maintaining biodiversity. Our goal was to review those prescribed burning measures which could be integrated to the European grassland management practice and we enlisted those habitats in which fire management potentially can be applied. We found that not only the application of fire management is scarce in Europe but there is a lack of published studies on this topic. These studies usually describe yearly dormant-season burning, and conclude that this burning type solely is not appropriate to preserve and maintain species-rich grasslands. In North-America application of burning has a stronger practical, historical and scientific background; it is fine tuned in terms of timing, frequency and generally combined with restoration measures (grazing, seed sowing or herbicide application). By this complex approach several nature conservation goals can be fulfilled like landscape-level heterogeneity and invasion control. We emphasize that for the application of prescribed burning the general findings of carefully designed case studies should be combined with the practical knowledge of conservation managers concerning the local application circumstances to reach specific management objectives.

P1 - EFFECT OF CHANGING MANAGEMENT PRACTICES ON THE GRASSES IN LOWLAND MEADOW

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Since 1974 the Experimental Ecological Garden of the Białowieża Geobotanical Station, University of Warsaw, has been the site of long-term studies on the course of secondary succession on abandoned agricultural land. Since 1984 the observations have also been carried out biannually on a control plot (22 x 10 m²) maintained as an annually-mown, unfertilized meadow. This variant of experiment is used to evaluate the effects of the anthropogenic modification (inhibition) of the secondary succession process by controlled mowing. The aim of the study is to assess the effect of anthropogenic disturbance on the qualitative and quantitative share of grasses growing on the experimental meadow.

Analysis of species composition has allowed the detection of surprisingly large changes in the dominance and frequency of individual grass species during the 28 years of investigations. An overall number of 21 grass species has been recorded as occurring on the experimental plot during that time. The percentage of area covered by grasses ranged from 11.9% in 1984 to 45.8% in 2008. During the initial years, *Dactylis glomerata*, *Agrostis gigantea* and *Anthoxanthum odoratum* were the numerically dominant species. After 1990, *Arrhenatherum elatius* and *Holcus lanatus* spread and took over, with *Trisetum flavescens* joining them more recently. Some grass species (*Agrostis gigantea*, *Alopecurus pratensis*, *Holcus lanatus*) have shown significant fluctuations in their frequency and/or coverage area. Other species (*Elymus repens*, *Poa pratensis*, *P. palustris*) were continuously and gradually receding. The year 2008 was marked by an exceptionally lush development of grasses. The entire area percentage covered by them increased nearly twice with regard to the previous observation (*Holcus lanatus* increased more than three times). Between 2008 and 2012 cover of *Dactylis glomerata* increased almost two and half times, whereas total cover of grasses diminished slightly (from 45.8% in 2008 to 38.3% in 2012). It seems that the main reason for the recorded floristic transformations were changes in the mode of management, e.g. the transition from mowing by scythe (medium disturbance level) to mechanised mowing (since 1992), first by a sickle bar mower (high disturbance level), and then by trimmer (since 2008; low disturbance level). Other factors governing the floristic composition of the investigated meadow are: the relatively late time of mowing, which occurred in July, making it possible for a number of grasses to ripen and spread their seeds; weather fluctuations from year to year; biannual trampling of the plant cover by observers, which made it more difficult for mowers to remove biomass from the meadow (self-fertilization effect); as well as increasing shading from nearby trees, changing transpiration and soil humidity.

P2 - TRAIT-BASED ANALYSIS OF SPONTANEOUS GRASSLAND RECOVERY IN SANDY OLD-FIELDS

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Based on the spontaneous vegetation development of old-fields in acidic and calcareous sand regions we aimed at to answer the following questions using the chronosequence method: (i) How do the proportions of functional groups change during succession? (ii) Which target species establish successfully in the old-fields during the succession? (iii) How useful is spontaneous succession in the recovery of target grasslands?

Two sand regions of the Great Hungarian Plain were investigated: (i) calcareous sand region of Kiskunság (Central-Hungary), and acidic sand region of Nyírség (East-Hungary). Altogether 24 old-fields are classified into young (less than 10-year-old), middle-aged (10-20-year-old) and old (20-40-year-old) fields; four old-fields were in each age-category. For baseline vegetation reference 3 open and 3 closed sand grassland stands in both regions were sampled in the vicinity of old-fields. Percentage cover of vascular plants was recorded in five 2x2-m-sized plots each field, in early May and late June 2012. Species of Festuco-Brometea class were considered as target species. The cover of hemicryptophytes and geophytes increased, the cover of short-lived species decreased with time. We detected a positive correlation between the mean cover of each perennial species of 'Young' and 'Old' old-field age-groups. Cover of species without clonal-spreading ability decreased, while covers of the species with clonal-spreading ability increased with the increasing field age. The cover of invasive species decreased with increasing field-age. Majority of target species established already in the young and middle-aged old-fields, although their cover was significantly higher in the two older age-groups.

Spontaneous succession can be a useful option in recovery of sand grassland vegetation in Central-Europe. The majority of the species pool of sandy grasslands can be recovered in the first 10-20 years. However, the success of grassland recovery can be strongly influenced by the surrounding species pool, and it is slow if seed dispersal is limited. The spontaneous succession is the most promising when the target species of grasslands immigrate at the very beginning of the succession in the first few years.

P3 - HABITAT-SPECIFIC CHANGE DETECTION AND TRAJECTORY ANALYSIS – A POTENTIAL TOOL FOR CONSERVATION MANAGEMENT

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Change detection and trajectory analysis are frequently applied methods for studying landscape change. Most studies on landscape change apply land-cover or land-use categories, because the available sources of cartographical and remotely sensed material support this approach. To prepare and analyze spatio-temporal datasets, large-scale historical maps are used. Their keys include mostly categories on land cover and land use. Dividing land-cover categories into finer habitat categories offers an opportunity for a more precise historical analysis of certain key or endangered habitats. Habitat-specific change trajectory analysis offers a chance to carry out a spatially explicit analysis, to separate primary and secondary patches of a certain habitat or the causes and stages of processes at the habitat scale. Future restoration of semi-natural habitats has growing importance according to the European Union Biodiversity Strategy to 2020. One of the first steps to this can be to prepare maps with long-term habitat changes, to serve baseline information on earlier habitat configurations for planning ecological networks, green infrastructure and multifunctional landscape in the future.

Our goal was to find out to what degree habitat-specific change detection analysis and trajectory analysis provide different information on major directions of landscape change than does the analysis with traditional land-cover statistics. Can these analyses highlight trajectories that remain invisible in land-cover change analyses? We have selected a landscape in which both, forests and grasslands are represented by several types, whereas soil pattern and land use is heterogeneous at fine scale, and the landscape is highly dynamic. Since landscape changes tend to be scale-dependent, we carried out the analyses at two different scales, using a regional and a local sample area (regional, 1800 km², 360 random points; local, 23 km², polygon-based maps) in the Kiskunság, Hungary. Spatio-temporal databases were prepared using historical maps, aerial photos and satellite images from 1783, 1883, 1954, and 2009. Local expert knowledge of landscape history and recent vegetation was used during the historical reconstructions.

We found large differences at both scales between land-cover based and habitat-specific analyses. Habitat-specific change detection revealed that grassland loss was not continuous in the different habitats, as land-cover based analysis implied. Ploughing affected open sand grasslands and sand steppes differently in different periods. It was only apparent from the habitat-specific analyses that among the grasslands only mesotrophic meadows were relatively constant, up until the 1950s. Habitat specific trajectory analysis also revealed ecologically important historical differences between habitats.

P4 - SPECIES RICHNESS OF GRASSLAND FUNGI AND VASCULAR PLANTS ALONG BIOGEOGRAPHIC GRADIENTS IN NORWAY

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Grassland species richness is declining due to changes in agricultural practice over the last decades. Abandonment, intensification and habitat loss are the main negative impacts in Norway, as elsewhere in Europe. The Norwegian semi-natural grasslands are the northernmost in Europe reaching as far north as to the Arctic border. Due to large geographical extent and heterogeneous topography there is a large variation in species composition and richness. Within these grasslands, vascular plants and fungi are among the most diverse species groups, including a large fraction of red listed species. The diversity of grassland fungi is generally poorly known, and little is also known whether there are congruent patterns of diversity in these two species groups. An important prerequisite for the management of the semi-natural grasslands is to understand the distribution patterns of different taxonomic species groups. Species richness is expected to decrease towards north, however the rate of decrease may vary and plants and fungi may show contrasting patterns. This study aims at elucidating patterns of species richness of grassland plants and fungi along biogeographic gradients in Norway.

The grasslands were selected from a database of important sites for biodiversity, managed by the Norwegian Directorate for Nature Management (www.naturbase.no). Within twenty regions chosen to represent the major

biogeographic variation in Norway, five grasslands were randomly selected from the database. The selected grasslands span more than 12 degrees latitude and are situated between 58.07 and 70.47 degrees north and between 5.16 and 29.99 degrees east. All vascular plants and grassland fungi were recorded in each of the 100 grassland sites during the period 2009-2012. Species were classified as grassland species based on information in literature and expert judgement.

The number of grassland fungi and plant species per site were analysed separately with explanatory variables including biogeographic region (vegetation zones and sections), latitude, longitude, altitude, and site area. Relationships between total species richness and the richness of red-listed species of grassland plants and fungi were also analysed.

A total of 277 grassland plants and 119 fungi, of which 34 plants and 61 fungi are red-listed, were recorded. Preliminary results show that species richness of vascular plants is positively correlated with the number of grassland fungi, and both the number of red-listed plants and fungi. However, the number of red-listed plants was not significantly correlated with the number of grassland fungi, or the number of red-listed fungi. The average number of red-listed fungi per site was higher than the average number of red-listed vascular plants.

The geographical patterns of species richness of grassland fungi and plants will be elucidated further, and results will be discussed in relation to biogeographic gradients.

P5 - MONITORING GRASSLANDS HABITATS IN MOLISE: FROM INDICATORS SELECTION TO CONSERVATION STATUS ASSESSMENT

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Dry grasslands, belonging to the habitat 6210(*) - Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (*important orchid sites), display a very high species richness but are, at the same time, seriously threatened by current climatic trends and land-use changes. These grasslands are determined by human activities and, in general, they need for active conservation actions in order to be preserved. Although the conservation of this habitat is a priority, there is no policy regarding the conservation of such grasslands.

Here we present some results of a PhD project also aimed at proposing and testing a methodology to assess the conservation status of the habitat 6210(*) in Molise. We identified some indicators which can represent a useful tool for conservation strategies aimed at preserving these types of grasslands. On the basis of the criteria suggested in the Habitats Directive and starting from indicators (here also called parameters) which have been suggested in other Member States, we operated a selection of the most suited and we adapted their ranges of favorable conditions to the local situation. The parameters were inferred from floristic and vegetation data. They allow to evaluate the structure of the grasslands, highlighting the presence and type of pasture or mowing, and the vegetation dynamics. Besides, we assessed the floristic coherence, also focused on the presence of species of special biogeographic interest and conservation value, such as Orchids but also plants that have, in their distribution range, areas naturally dominated by grasslands, that can help to distinguish the priorities for conservation.

P6 - THE EFFECT OF DIFFERENT MOWING REGIMES ON THE SPECIES RICHNESS AND COVERAGE OF VASCULAR PLANTS AND BRYOPHYTES

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The aim of the study is to find the best management type for maintenance of species richness of both vascular plants and bryophytes on mesophytic meadows. Four different mowing regimes were used during seven years on a riverside meadow in South Estonia.

The management regimes were: 1) raking and mowing once in summer, removing hay; 2) raking once and mowing twice in summer, removing hay; 3) mowing twice in summer, removing hay; and 4) mowing once in summer without hay removal. Forty 50x50 cm permanent plots, ten for each treatment, were established on the meadow. The initial analyses were done in 2004, the final ones in 2011.

The results show that high species richness for vascular plants was achieved by all regimes except mowing once without hay removal. For bryophytes the highest species richness was achieved in the two regimes with raking and the regime without hay removal resulted also with the lowest richness. The summer coverage of vascular plants did not differ due to treatments, but the coverage in autumn was highest by raking and mowing once. The coverage of bryophytes was significantly lower by the regime without hay removal.

In conclusion, the regime to keep meadows open by mowing without hay removal does not support plant richness. The best management regime to maintain high species richness for both plant groups is the traditional one used in Estonia (raking and mowing once with hay removal).

P7 - CHANGES IN NARDUS SWARDS OF THE WERRA-MEISSNER REGION AFTER 25 YEARS

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Nardus swards are extensively used grassland communities growing on nutrient poor, siliceous soils. Intensified land use and abandonment are major threats for this endangered vegetation type. As a priority European habitat type (6230, Species-rich *Nardus* grasslands), their preservation and an appropriate management is a matter of importance for nature conservation.

Vegetation relevés of *Nardus* grasslands in the Werra-Meissner region (Northern Hesse, Germany) from 1986/87 were compared with re-recordings of 2012. The aim was to detect changes in floristic composition, vegetation structure, soil parameters and management to obtain information about their development during the last 25 years. We were especially interested in the impact of land use change, altered nutrient status and possibly climate change.

The data were analyzed at different levels (overall data set; subsets defined by region, bedrock and land-use). Site variables (pH, CN ratio) and collective properties of vegetation (species richness, mean indicator values) were compared using t-test, Wilcoxon test and analysis of variance. Shifts in floristic composition were analyzed with ordination techniques.

The results show that *Nardus* grasslands of the region are much more frequently used than 25 ago, when there was a high proportion of abandoned sites. Significant changes in species composition and vegetation structure have taken place. Overall species richness, however, is approximately unchanged. Yet, different tendencies within the individual regions and land use types can be noticed. An increase of pH and decrease of CN ratio is reflected by increased mean R and N indicator values. Possible reasons for this are both the release of nutrients by re-established management and atmospheric deposition. Hence, eutrophication is an important challenge for maintaining the quality of *Nardus* grassland and has to be met by suitable nature conservation measures.

P8 - THE DIVERSITY OF MORPHOLOGICAL STRUCTURE AND OF BIOMASS OF *OSTERICUM PALUSTRE* BESSER ON THE MEADOWS BEING UNDER AGRICULTURAL ENVIRONMENTAL PROGRAMME

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The study was conducted in 2010, in the fresh, double-cut meadows staying under agri-environmental programme (1st cut 1st of July) and also outside of it (1st swath 15th of June). Specimens of *Ostericum palustre* were collected just before the 1st and 2nd swath from the 4 research areas, and also from areas which were not

mowed. Morphological features of the shoots were analysed as follows: height, length of internodes, number of shoots, weight of stems, leaves' rosette width, length of leaf and its petiole, assimilation surface of the leaves, leaf weight, height of inflorescence, number of inflorescences, number of peduncle within main inflorescence, the mass of inflorescences, fruit weight, the weight of peduncles and inflorescence stems.

The highest values of all analyzed features characterized the population of *Ostericum palustre* from surfaces which were not under agricultural pressure. Before 1st swath generative shoot is already partially evolved in the meadows covered by agri-environmental programme, while in the meadows cultivated with traditional methods plants stay in their vegetative phase.

Before 2nd swath, when comparing with individuals drawn from the meadows not covered by agri-environmental programme, *Ostericum palustre* colonizing surfaces under this scheme, are lower. We observe significant differences in the weight of ripe fruit. Time of a 1st swath (1st of July) shows therefore bad influence on structure and biomass of *Ostericum palustre*.

P9 - LITTER IS CRUCIAL IN SUPPRESSION OF WEED SEEDLING ESTABLISHMENT IN GRASSLAND RESTORATION - INDOOR GERMINATION EXPERIMENT CONFIRMS FIELD EVIDENCES*

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In the early stages of grassland restoration the suppression of weed species is essential. Litter accumulation can hamper weed establishment by decreasing the availability of open surfaces, which is essential for the germination of short lived weed species. Experiences gained from field studies support these expectations; however, we are still lack of such results by controlled germination experiments. Our aim was to test the functional importance of litter in weed suppression both in an indoor germination experiment and in a field study. In the indoor germination experiment we studied the effects of increasing litter cover on seedling establishment of six short-lived Brassicaceae species with different seed masses. Small-seeded species were more sensitive for litter cover; all of them were negatively affected by thick litter layers. In contrast, no negative litter effect was detected for large-seeded species. No overall positive litter effect was found, although the detected seedling numbers for most of the sown species was not the highest at the bare soil pots. Our results suggest that the negative effects of litter are seed size dependent; large-seeded short-lived species are affected less than small-seeded ones. In the second study we explored the effectiveness of low diversity seed sowing and hay-transfer in weed suppression and recovery of perennial grassland vegetation. The study site was in Hortobágy Puszta, East-Hungary. We emphasize that the joint application of these methods has the potential to gain a directed vegetation development with effective early weed suppression. According to our findings the additional application of hay significantly accelerated the development of perennial grassland vegetation and increased weed suppression rate in the first year and onwards than seed sowing only. Establishment rate of perennial grasses including *Festuca* species was higher in all plots with hay addition than with sowing only. Our results suggest that the combination of hay transfer and low diversity seed sowing is a successful restoration technique. It could be a cost-effective alternative to the more costly high-density sowing. If proper sources for high-diversity hay are available, it may replace high-diversity seed mixtures. According to our findings germination of weeds under litter cover is seed size dependent, but the targeted grassland species are not hampered by litter cover.

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P10 - TOPOGRAPHICALLY CONTROLLED SOIL MOISTURE DRIVES PLANT DIVERSITY PATTERNS WITHIN GRASSLANDS

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Grasslands are recognized as biodiversity hotspots in Europe. However, protection and management of these habitats is currently constrained by a limited understanding of what determines local grassland plant diversity patterns. Here, we combined vegetation records (8639 inventory plots) from 258 semi-natural grasslands with fine-resolution topographic data based on Light Detection and Ranging (LiDAR) technology to investigate the importance of topography – particularly topographically controlled soil moisture – for local and regional grassland plant diversity patterns across a 43000 km² lowland region (Denmark). Specifically, we examined the relationships between five vegetation measures representing species composition and richness as well as functional composition (Ellenberg indicator values) and four functional topographic factors representing topographic wetness, potential solar radiation, heat balance and wind exposure. Topography emerged as an important determinant of diversity patterns in both wet and dry grasslands throughout the study region, with topographic wetness being the strongest correlate of the main local (within-site) and regional (among-sites) gradients in species composition and species' average preferences for soil moisture. Accordingly, topography plays an important role in shaping grassland plant diversity patterns both locally and regionally throughout this lowland European region, with this role mainly driven by topographically controlled soil moisture. These findings suggest hydrology to be important to consider in the planning of conservation and restoration of European grasslands.

P11 - CULTIVATION AND HYBRIDIZATION ALTER THE GERMINATION BEHAVIOR OF NATIVE PLANTS USED IN RE-VEGETATION AND RESTORATION

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Native plants are increasingly used for re-vegetation and restoration. These plants are cultivated for several generations at plant nurseries and often they are of unknown provenance. Therefore, cultivated plants often differ from their wild progenitors in life-history traits. Using germination behavior as example, we tested the assumption that cultivated plants have different life-history traits than their uncultivated progenitors. Cultivated as well as wild individuals of *Plantago lanceolata* and *Lotus corniculatus*, two species frequently used in re-vegetation, were tested in a common garden experiment as well as in incubators for their germination behavior. We observed significantly faster and more abundant germination in cultivated varieties. Using artificial crossings we found that also hybrids of cultivated varieties and wild relatives germinate faster and more abundant than the wilds. As wild plants acquire their life-history traits by natural selection, we have to assume that they represent the optimal adaptation to the environmental conditions. If these traits are changed by cultivation or by hybridization between cultivated varieties and local populations, the long-term survival probabilities of local populations may be altered. Therefore, the use of cultivated varieties of native plants should be avoided in re-vegetation.

P12 - SUSTAINABLE AND PROMISING GRASSLAND RECOVERY ON EXTENSIVELY MANAGED LUCERNE FIELDS

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Spontaneous succession is in the mainstream of current ecological research, but only a few studies concern with the applicability of spontaneous grassland recovery in grassland restoration projects. Spontaneous succession after the cessation of intensive crop production is an economic way of grassland restoration on ex-arable fields with little implementation costs. We studied the spontaneous recovery of loess grasslands in extensively managed lucerne fields (*Medicago sativa*) mown twice a year using space for time substitutions to highlight the importance of spontaneous processes in grassland restoration. With increasing field age a gradual replacement of lucerne by perennial native grasses and forbs and increase of mean species richness was detected. As the age of fields increased, the cover of lucerne decreased from 75% to 2%, whereas the cover of perennial grasses increased from 0.5 to 50%. Total vegetation cover showed no significant differences between the age groups; weed cover was less than 10% in every age group. The biomass of lucerne was negatively correlated with grass

biomass. As the age of the fields increased, the biomass of lucerne decreased and that of grasses increased. There was no litter accumulation and no increase of total biomass with increasing field age. Native grasses of loess grasslands recovered within 10 years, but characteristic native forbs remained rare. The advantages of spontaneous succession in lucerne fields compared to technical reclamation include: (i) no weed dominated stages, (ii) no considerable litter accumulation, (iii) a spontaneous decrease in the cover of lucerne with time and (iv) negligible cost. In addition, farmers can be more involved in mowing management because of the high forage value of lucerne in the first years. The restoration of species rich grasslands will require more active management such as propagule transfer by hay and/or moderate grazing to encourage the return of native forbs.

Session G2 - Fragmentation and management of calcareous grasslands

Chairs: V. Rösch¹, P. Batáry¹ & C. Scherber¹

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Calcareous grasslands belong to the most species rich habitats in Europe, but are increasingly threatened by habitat fragmentation and abandonment. They are semi-natural habitats, mostly created by extensive grazing or mowing in past centuries, which resulted in diverse plant and invertebrate communities adapted to dry and warm climatic conditions and extensive management. In the era of agricultural intensification the economic importance of these nutrient-poor grasslands decreased drastically. Therefore, management was either abandoned leading to shrub encroachment, or in some cases fertilizer was applied in order to increase yield. Thereby a large part of these grasslands has been lost throughout Western and Central Europe leading to increasingly fragmented grassland patches surrounded by intensively managed landscapes. Habitat fragmentation and at the same time cessation of transhumance shepherding, which used to link grasslands, disrupt dispersal processes, increasingly isolating populations from each other. However, in fragmented habitats some organisms such as grassland specialist plant species are able to persist for a longer period of time than short-lived organisms such as most invertebrates (i.e. longer extinction debt for plants). This might light up the chance of successful, but probably expensive restoration of calcareous grasslands. From conservation point of view, the maintenance of the remaining calcareous grasslands might be a cheaper and better way, which now mostly relies on agri-environmental schemes and other conservation oriented management actions. Extensive grazing with sheep or goats and late-season mowing depending on the conservation focus (e.g. orchids) are seen as appropriate management measures. Finally, there is still ongoing long-term debate on whether to preserve single or few large or several small fragments (the so-called SLOSS-debate), which is also a question to calcareous grasslands. Several small fragments together may support a higher diversity than a single large fragment, which on the other hand may exhibit greater habitat stability and be less prone to extinction events due to larger populations. This also suggests the importance of landscape-scale studies in order to satisfy the requirements of conservation actions.

O1 - RESTORING INSECT DIVERSITY ON CALCAREOUS GRASSLANDS: THE IMPORTANCE OF MICROCLIMATE

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The conservation of the extraordinary species richness on calcareous grasslands has long been undertaken with a focus on plant species and communities. The necessity of appropriate management for the insect fauna is only gradually being recognized. The characteristic insects of calcareous grasslands typically require warm microclimates, especially during the larval stage. In addition the life-cycle of many insect species, especially in temperate regions, is highly synchronized in time. This means that habitat conditions for each stage in the life-cycle must be present at the right time of year, making insects especially sensitive to the timing of grazing management. Thus, accommodating insects in habitat management requires a stronger focus on microclimatic conditions.

The importance of warm spring microclimates on calcareous grasslands have been investigated in detail in the butterfly, the Glanville fritillary (*Melitaea cinxia*). The larvae of this species hibernate gregariously and thermal measurements show that they depend on solar irradiation in early spring for successful development. We have come across two very different processes threatening these optimal spring microclimate conditions. First, microclimates are susceptible to a cooling trend by anthropogenic nitrogen deposition and abandonment, which increase vegetation growth and, hence, decrease solar irradiation. European trend data provide evidence that this is a common threat for many spring-developing insects. Second, extreme weather events, which are believed to become more frequent due to climate change, can strongly alter local microclimatic conditions during critical periods. An example of this was witnessed in 2011 when extreme spring drought decimated *M. cinxia* populations on a dry calcareous grassland slope, presumably because of a lack of vital host plants. Populations from a moister slope on newly restored calcareous grassland survived much better. We argue that there is a need to design restoration management to improve microclimatic conditions to

accommodate the insect fauna. This involves a careful application of grazing management or hay-making with differentiation in space and time. Moreover, in the light of weather extremes, we emphasize the importance of extending habitats over a wider range of slope aspects and soil conditions.

O2 - INTEGRATING LOCAL AND REGIONAL PROCESSES IN MANAGEMENT AND RESTORATION OF CALCAREOUS GRASSLAND METACOMMUNITIES

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Calcareous grasslands suffer from local alteration of habitat conditions, like abandonment or fertilization, as well as from spatial processes acting at a regional scale, like habitat loss and fragmentation. Consequently, conservation of these ecosystems focuses on maintaining or improving local site conditions by appropriate management and on the enlargement and reconnection of remnants of historical grasslands through restoration. However, these measures do not always match species' requirements for dispersal and persistence, and are therefore ineffective in supporting local and regional species richness and to functionally reconnect sites. Here, we present a conceptual framework and first results of a study in which we (i) identify the limiting processes for plant dispersal and persistence in metacommunities of historical and restored calcareous grasslands, (ii) evaluate current restoration measures at the landscape scale, and (iii) guideline future activities for a functional reconnection of historical calcareous grassland remnants. In the first study, measures of community structure (i.e. species and functional composition and diversity) are used to infer community assembly processes and to model them against local site factors (soil variables, management, habitat heterogeneity) and landscape factors (habitat size, habitat loss, isolation) for a number of historical calcareous grasslands in the German Alpine Foreland. This will allow statements on the relative importance of these factors as a filter on the regional species pool.

In a second study, the same community and descriptor variables are sampled from restoration sites. The metacommunity conceptual framework is used to identify the spatial dynamics within the regional set of restored and historical grassland communities. This can inform if existing restoration sites are able to functionally reconnect historical grasslands in terms of reachability as well as abiotic and biotic site conditions.

In a complementary field experiment conducted in March 2013, we test how community assembly processes change along environmental gradients in restored grasslands. As these processes drive the structure of plant communities, their knowledge will help to choose and prepare restoration sites and to select adequate seed mixtures. This will ensure that restoration sites are able to functionally reconnect historical grassland remnants based on suitable abiotic and biotic site conditions.

Finally, we analyze the genetic structure within and among historic and new populations created through hay transfer or seeding of a target species, using *Buphthalmum salicifolium* L. as example. The goal is to study the extent of geneflow and the amount of transferred genetic diversity which determine the evolutionary potential of restored populations in the landscape.

O3 - EFFECTS OF CURRENT AND PAST MANAGEMENT ON CALCAREOUS GRASSLAND VEGETATION AND THE ROLE OF DISPERSAL IN GRASSLAND MANAGEMENT

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Most calcareous grasslands are remnants of previous extensive grazing or mowing regimes. Relict grasslands in human-affected landscapes are often quite small and house only small populations of characteristic grassland species. In such fragmented landscapes, dispersal limitations in combination with local extinction processes limit the species diversity of these small grassland sites. Moderate disturbance or removal of biomass is essential to preserve these sites. Increasing atmospheric input of nutrients increases the need for nutrient removal from

nutrient-poor grasslands. A variety of management methods are applied in nature conservation, ranging from different mowing and grazing regimes to prescribed burning.

We compared the effects of different management methods on vascular plant and cryptogam species diversity and species composition at three different calcareous grassland sites in Germany and Switzerland. Annual mowing and grazing by sheep led to the highest species diversity of all plant groups, while less frequent cutting and fire management led to decreased species diversity and changes in species composition. Management affected species diversity and species composition for many years even after the cessation of the management measures. After 6 years of homogenous mowing regime, previous fire management plots showed lower species diversity and higher grass cover than previously mown plots, as well as an almost complete absence of cryptogam species. In comparison with regularly mown grasslands, fallow grassland sites showed a strong increase in pleurocarpous moss cover and moss dry mass, inhibiting low growing vascular plant species. This effect may also occur on annually mown grassland sites with high nutrient levels in the soil, e.g. at many restoration sites.

If management of isolated grasslands is resumed after a longer fallow phase, many locally extinct grassland species will be unable to colonize the site due to dispersal limitations. We studied cryptogam species characteristic for calcareous grasslands, e.g. pleurocarpous mosses that disperse only by fragments. Measurements of the largest individuals of pleurocarpous moss and epigeaic lichen species at successional and restored sites indicate dispersal limitations, in contrast to acrocarpous moss species dispersed by spores.

Hay from species rich grassland sites used for grassland restoration often contains bryophyte and lichen fragments. Analysis of hay samples from a nature reserve showed that large amounts of cryptogam species are transferred to restoration sites by hay transfer. At dry grassland restoration sites, this may have the unwanted effect that pleurocarpous mosses brought there by hay transfer cover large areas before early succession cryptogam species can colonize the site, resulting in reduced species richness of cryptogams.

Our results show that dispersal limitations are a serious problem in fragmented landscapes, especially if the sites are small and isolated. Management and restoration methods to overcome these limitations will be necessary to maintain and restore species diversity at these sites.

O4 - PASTURE MANAGEMENT AFFECTS LAND SNAIL DIVERSITY IN NUTRIENT-POOR CALCAREOUS GRASSLANDS

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Dry, nutrient-poor calcareous grasslands have been recognized as regional biodiversity hotspots. However, semi-natural grasslands are fragile because their maintenance depends on traditional farming techniques. In the past decades, increasing pressure for higher production at low costs led to either an intensification of grassland use (increasing stocking rate and/or increased use of fertilizer) or to abandonment. We examined the influence of horse, cattle and sheep grazing on the diversity, abundance and species composition of land snails in calcareous, nutrient-poor grassland areas in the Swiss Jura mountains. Grazing by different livestock species did not affect the species richness, abundance and species composition of land snails. However, independent of livestock species, grazing intensity negatively influenced the snail fauna. Snail species richness, abundance and number of red-list species decreased with increasing grazing intensity. Grazing intensity also negatively affected the occurrence of certain snail species, particularly of specialized openland species. Furthermore, former land use influences the present-day gastropod communities. Recent management actions aim to restore overgrown and formerly fertilized nutrient-poor grassland in the Swiss Jura mountains. We surveyed gastropod communities in pastures left unmanaged for 10–40 years but recently cleared from overgrowing shrubs, in pastures fertilized for 15–25 years but recently managed extensively (no fertilizer), and in pastures which have been extensively managed throughout (= control). Past shrub cover had a negative effect on the number of snail species and the number of red-listed individuals. Former use of fertilizer reduced both the number of red-list species and individuals and changed the snail community. It is concluded that man-assisted introductions of specialized land snail species are necessary to improve the restoration success of degraded semi-natural grasslands.

O5 - EXTINCTION DEBT AND INVASION OF NON-CHARACTERISTIC SPECIES IN EUROPEAN CALCAREOUS GRASSLANDS

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Calcareous grasslands in Europe are characterized by large changes in environmental conditions and habitat spatial configuration during past century. With loss of habitat area and changed habitat quality, numbers of characteristic species are expected to go locally extinct from historically developed grassland communities. However, decline in biodiversity following environmental perturbation might not be immediately evident due to the phenomenon of extinction debt. Extinction debt means that for a number of species in local community, the habitat conditions are not suitable for long-term persistence, but the actual extinction event has not yet occurred due to the slow intrinsic dynamics of populations. We used large dataset consisting over 600 individual grasslands from 10 regions ranging from Spain to Finland to investigate the existence of extinction debt in European grassland systems. We identified the grassland regions where extinction debt is more pronounced and regions where the species number is in concordance with current habitat conditions i.e. the extinction debt is most likely already paid. We found that in western European countries, remnant grassland patches are relatively small and plant species richness is strongly related to current grassland area. In eastern Europe and in traditional landscapes in Sweden, however, grassland patches were considerably larger and current habitat area was poor predictor of grassland plant richness. Over all studied regions, relative richness of non-characteristic species increased with decreasing habitat area, indicating the higher susceptibility of small remnant grassland patches to invasion by generalist species. When studying the relationship between habitat area and average plant life-history trait values, we identified that good dispersers are most threatened by habitat loss. Most likely the dispersal ability (and inversely related local persistence ability) are the key factors influencing species vulnerability to habitat loss.

In conclusion, grasslands in several European regions showed good concordance between species number and current habitat area. In these systems, further habitat loss should be avoided in order to maintain the grassland biodiversity. However, in regions where extinction debt still occurs, habitat restoration is urgently needed to prevent extinction of susceptible species and infiltration of non-characteristic species.

O6 - THIRTY YEARS OF CHANGES IN THE EXTENT AND VASCULAR PLANT SPECIES COMPOSITION OF *BROMUS ERECTUS* SEMI-NATURAL GRASSLANDS

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Semi-natural dry grasslands are among the most species rich plant communities in Europe and their value for nature conservation is recognized at the international level. As their maintenance depends on active extensive management, the area of semi-natural grasslands has suffered a sharp decline over the last century, because of the land use changes occurred throughout Europe, mainly due to the abandonment of traditional agricultural practices. In Italy the extent of grasslands has decreased markedly in the whole country, particularly in the Apennines, where grassland area has been almost halved during the last 40 years.

Here we present a multi-temporal analysis of semi-natural calcareous dry grasslands belonging to the Habitat 6210 (Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)) (European Directive 92/43/CEE). In our study we aim: i) to assess changes in habitat extent and in vascular plant species composition, and ii) to define the main drivers of such variations.

The study was performed in Monte Catria (central Italy) and was based on the comparison between historical and current phytosociological data. Especially, we selected published relevés performed about 30 years ago and associated with detailed vegetation map (1:15000). This spatial information on the published relevés allowed us relating them to new relevés that were performed at sites as close as possible to the original sites. We estimated the changes in vascular plant species composition through a multivariate analysis between the present and the historical relevés. We also analyzed the variations in the extent of grasslands patches through the comparison between the map and recent aerial photos.

We analyzed the dynamic of change in 111 patches of *Bromus erectus* semi-natural grasslands, and the vascular plant species composition in 20 of them. Landscape metrics (area, perimeter, contacts and distance from other grasslands patches) and management data (number of grazing animals per year since 1968) were recorded to identify the drivers of the observed changes. Within the study area we found different levels of variation in vascular plant species composition and the drivers of such variation varying at different altitudes. A decrease in the total extent of the habitat area was found even if different degree of variation was pointed to in relation to the distribution of the grazing activity.

This project will be carried out in at least other four study areas along the Apennine chain, and we would like to widen our perspective to Southern Europe through collaborations with other European researchers.

O7 - EFFECTS OF FRAGMENTATION ON PLANT COMMUNITIES IN DRY CALCAREOUS MEADOWS – THE IMPORTANCE OF SPECIES TRAITS

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Landscape changes that result in habitat loss and fragmentation represent one of the most serious threats to biodiversity. Many red-listed species have naturally low abundances and are spatially clustered in certain types of habitat. Combined with anthropogenic changes in land use, which reduce the amount of a restricted habitat even more, species dependency on such restricted habitats can lead to species decline and increase the risk of extinction. Dry calcareous meadows in Norway are restricted to sites with bedrock of Cambro-Silurian origin frequently exposed to drought, due to a combination of high soil drainage and exposure to wind and sun. Such sites can be found in a narrow zone between the sea and forested inland areas around the Oslo fjord. The habitat has a high occurrence of red-listed species, including vascular plants, lichens, fungi and invertebrates. Due to the dependency on a combination of bedrock qualities, exposure and climate, dry calcareous meadows are naturally fragmented, but as the habitat is found in the most densely populated area of Norway, human impact has led to further reduction in habitat patch sizes and increased distances between them.

Species respond differently to habitat loss and fragmentation; the response being mediated by the species' life-history and functional traits. Consequently, small, isolated habitat patches can be expected not only to contain fewer species, but also to differ in species composition compared to large, well-connected habitat patches. In this study we investigate the importance of landscape characteristics (patch size and connectivity), local environmental variables and plant functional traits for vascular plant species assemblages in fragmented dry calcareous meadows. The dataset includes plant species occurrence in 86 habitat patches of varying size and connectivity and plant species abundance in a subset of 20 patches. Plant functional traits important for dispersal, establishment and persistence were compiled from databases.

A total of 381 vascular plant species, of which 50 can be characterized as habitat specialists, were recorded in the 86 habitat patches. Both the number of habitat specialists (in 86 patches) and the abundance of these (in 20 patches) were highest in large, well-connected patches. Two research questions will be explored: (1) what is the importance of landscape characteristics and local environmental conditions for species and functional composition of the plant communities, and (2) what characterizes the habitat specialist species that are vulnerable to fragmentation?

O8 - DELAYED RESPONSE IN A PLANT-POLLINATOR SYSTEM TO EXPERIMENTAL GRASSLAND FRAGMENTATION

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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. Fragments of different size (2.25 m² and 20.25 m²) were isolated by a 5-m wide strip of frequently mown vegetation. Control plots of corresponding size were situated in adjacent undisturbed grassland. 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. After 6 years of fragmentation seed weight was larger in fragments than in control plots. However, the densities of *B. officinalis* rosettes and inflorescences, plant height and inflorescence length were not affected by fragmentation. The outcrossing frequency of *B. officinalis* growing in fragments was reduced by 15% after 2 years and by 33% 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. This finding strengthens the claim for long-term field experiments with proper replications and controls to assess delayed effects of habitat fragmentation.

O9 - THE FATE OF SMALL, ISOLATED PATCHES OF SEMI-DRY GRASSLAND (CIRSIO PANNONICI-BROMETUM) – A CASE STUDY IN SOUTH-EASTERN STYRIA (FROM 2007 – 2013)

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Semi-dry grassland communities are rare and endangered throughout whole Central Europe. Often they are but remainders of former wide distributed or at least connected sites of extensively used semi-natural grassland. Some efforts on behalf of the Fauna-Flora-Habitat-directive of the European Commission but also of the provincial government have achieved to conserve some of these remainders. Others have failed due to fragmentation, isolation, lack of proper management or fringe effects from bordering croplands.

The issue of this study was to investigate the change of structure and species composition of several small, isolated patches of semi-dry grassland since 2007. Additionally we compared those small, isolated patches with larger, well-connected sites of semi-dry grassland in the same area.

The investigated area is located in the south-eastern alpine foreland of Austria near the community of Sankt Anna am Aigen (46.81 N/15.98 E- 46.81 N/15.99 E; 281 - 297 m a.s.l.). The soils are non calcareous Cambisol, Stagnosol and calcareous Leptosol. The annual precipitation is between 830 – 840 mm and the annual average temperature is between 9.1 – 9.3°C (1971-2000).

The study comprises several relatively large semi dry grassland sites of the *Cirsio pannonicum*-*Brometum* which are mowed regularly once or twice per year which are part of a management program and several smaller, isolated sites of the *Cirsio pannonicum*-*Brometum* lacking special protection or management. Besides sampling the vegetation (Braun-Blanquet approach, 25 m²) we analysed soil parameters (K, P, pH) and recorded the distance each of the samples to the nearest boundary of other species rich high value (semi dry) grassland. As comparison we used vegetation samples of the same sites from 2007. The treatment of the sites since 2007, as well as the influence of bordering vegetation was taken into account.

Preliminary results show us, that due to the lack of proper management and predominance of negative impacts of surrounding intensively managed croplands, both species composition and structure of the small, isolated patches of the semi-dry grassland were altered. Nevertheless a number of *Festuco-Brometea* species can still be found at the sites, which shows a certain resilience of semi-dry grassland vegetation to inappropriate management. At the same time the larger, well-connected and managed sites have remained more or less the same since 2007. Regarding to the joint efforts both of the Natura 2000 habitat management and the "Naturschutzbund" trying to create buffer zones in the boundary of some of the remaining larger semi-dry grassland sites their persistence in a good state of preservation can be expected.

O10 - SMALL VERSUS LARGE FRAGMENTS OF CALCAREOUS GRASSLANDS: SPECIES RICHNESS IS SIMILAR BUT COMMUNITY COMPOSITION DIFFERS ACROSS FOUR TAXA

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During the course of agricultural intensification calcareous grasslands became highly endangered due to abandonment, fragmentation and isolation. There is an on-going debate on whether it is better to preserve single large or several small fragments of the same area (the so-called “SLOSS”-debate).

We selected 14 large and 14 small grassland fragments in Central Germany differing in isolation from other calcareous grasslands and in the composition of the surrounding landscape, i.e. the percentage of arable land in a 500m buffer around each site. In order to span a wide range of different taxa, we surveyed plants, leafhoppers, true bugs and snails. Species-area-accumulation curves showed that both total species richness and specialist species richness were higher when summing the species that occurred on several small fragments than if only the species of one or two large fragments were considered. However, the rarest specialist species were mostly confined to the large fragments. Community composition of all four taxa was highly affected by fragment size, i.e. it greatly differed between large and small fragments. In most cases this was also true when looking at specialists and generalist species separately. Isolation from nearest grasslands and landscape composition were far less important, but leafhopper community composition was affected by landscape composition and true bugs depended on plant species richness.

We conclude that a focus on species richness alone is not sufficient to evaluate whether to conserve large or small fragments. On the contrary, the analysis of community composition allows much deeper insight and implies that the conservation of large but also of a set of small fragments of calcareous grassland is needed in order to preserve full species diversity.

P1 - CAN UKRAINIAN KURGANS (BARROWS) HOLDING STEPPE VEGETATION BE TREATED AS REAL ENVIRONMENTAL ISLANDS? – ASSESMENT OF DEGREE OF ISOLATION OF KURGANS WITHIN DIFFERENT VEGETATION ZONES

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Kurgans (barrows) are small mounds, usually with a diameter of about 20-80 m and a height of 2-10 m, built by ancient nomadic peoples in the place of burial. Kurgans of Ukraine are currently one of the few refuges of steppe vegetation, which has been mostly converted into cropland and has survived on the surface not exceeding 10% of the originally occupied area. Today barrows are located within large, intensively managed fields of cereals and oilseeds. The results of previous studies show that about 25% of barrows still hold vegetation rich in rare steppe species. Currently, they can become a unique object to conduct interdisciplinary studies on the effects of landscape fragmentation on the functioning of plant populations in the context of metapopulation theory and the theory of island biogeography.

Island biogeography theory, developed for real oceanic islands, assumes that the slope of species-area relationship for islands is steeper than for patches of continuous habitat. We would like to check whether that law applies to steppe flora on barrows and if there are differences between degree of isolation of kurgans from different vegetation zones.

Between 2008 and 2012 we studied 106 barrows holding valuable steppe vegetation. Among them 26 barrows within desert steppe zone, 26 within Pontic grass steppe zone (species poor variant), 29 within Pontic grass steppe zone (species rich variant) and 25 within forest steppe zone. We measured height and diameter of barrows to assess their area and carried a detailed floristic research to determine the total species richness of barrows. Recorded species were then divided into synanthropic and non- synanthropic ones. Species-area relationship curves were drawn separately for full species lists and only for non- synanthropic species for the total database as well as for the particular vegetation zones.

Results show that the kurgans can be treated and environmental islands only when non-synanthropic flora is taken into account. Moreover there are clear differences between different vegetation zones. The “island effect” (that can be considered as a measure of isolation) was strongest within desert steppe zone, probably as a result of different salinity between barrows and surrounding landscape.

The results reveal that habitat islands on the landscape level are not islands from the biological point of view for all species and their degree of isolation is dependent on the character of surrounding “matrix”. Our studies could make a point in a discussion over applicability of the island biogeography theory to the habitat islands within the agricultural landscape.

P2 - CONSERVING DRY GRASSLAND VEGETATION DIVERSITY BY FIRE AND GRAZING – A CASE STUDY FROM NNM KAŇK, KUTNÁ HORA, CZECH REPUBLIC

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The habitat of dry calcareous grasslands in Central Europe belongs to one with highest biodiversity potentials. However, it often depends on human activities that keep the landscape open. Here we present a case study of dry grasslands management from National Nature Monument Kaňk, Kutná Hora, Czech Republic. The site is a former small limestone quarry (active in the 19th century) with dry grasslands that hosts many valuable plant and invertebrate species. In addition, it hosts a viable population of endangered *Stachys germanica*. Due to lack of management in the last decades, it is now endangered by shrub and mesophilous grasses expansion (mainly *Prunus spinosa*, *Rosa* sp. and *Calamagrostis epigejos*).

For these reasons, permanent plots for the monitoring of vegetation were set up in 2009 and management started in the spring of 2011. The managed area consists of one heterogeneous grassland, with more degraded and more diverse vegetation patches and occasional shrubs or trees. Part of the grassland has been burned in early spring of 2011 and in the following months, grazing management with a small mixed herd of sheep and goats has been implemented on the whole grassland. The herd is present at the site each summer, from May/June to August, and the intensity of grazing is regulated according to specifics of each season to find balance between overgrazing and no grazing impact. Moreover, part of the shrubs has been cut before the start of grazing.

Permanent plots 1 m² are in two sets of four pairs of grazed and control plot; four pairs have been burned, four pairs were not touched by fire. In each pair, control plot is permanently covered by cage to avoid grazing. Results from yearly monitoring of vegetation show positive effects of grazing and fire on species diversity; control plots have higher proportion of old biomass and are dominated by grass, managed plots host more herb species and species proportions are more balanced. In addition, burning induced intense flowering and is the main factor that reduced old biomass.

To conclude, management strategies applied at NNM Kaňk seem to be suitable for dry grassland diversity recovery and conservation. It is also the variety of management practices that we find beneficial to the whole habitat.

Session G3 - Target species introduction for improving the conservation status of Natura 2000 grasslands and evaluation of restoration success

Chairs: **S. Dullau¹ & A. Baasch¹**

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During the last few decades, land use changes in Europe have led to a continuous decline in the area of semi-natural grassland rich in biodiversity. The Council Directive (92/43/EEC) requires the member states to take appropriate steps to maintain or restore natural habitats. However, many grasslands of European interest have been assessed as being in unfavorable conservation status. Even after years of appropriate management and although optimal site conditions prevail, they often still lack the typical species composition and diversity of semi-natural grasslands of high nature conservation value. The lack of appropriate seed sources in the nearby surroundings combined with the low potential for long-distance dispersal of many grassland species are two of the main reasons that hamper effective re-colonization of species-poor grasslands. Thus, when diaspora sources are lacking, species-poor grasslands need to be restored not only by an adjusted land use practice but also by introducing grassland species. Different methods of species introduction (e.g. sowing seed mixtures from regional origin and propagation, seed transfer of threshing, stripping or brushing material, green hay, etc.) may be used to establish target species and thus to improve the conservation status of grasslands.

In this session we want to summarize experiences in grassland restoration, particularly with regard to the semi-natural grassland habitat types 6410 (*Molinia* meadows), 6440 (Alluvial meadows of river valleys of the *Cnidion dubii*), 6510 (Lowland hay meadows), and 6520 (Mountain hay meadows). Presentations which focus on i) selection of target species for semi-natural grassland restoration, ii) site preparation of receptor sites, iii) examples of different methods of species introduction, iv) post species introduction site management, and v) methods for evaluation of restoration success with regard to habitat structure and species composition are very welcome.

01 - THE USE OF TARGET BROMION SPECIES FOR RESTORATION OF GRASSLANDS IN THE BÍLÉ KARPATY MTS.

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In the Bílé Karpaty Mts. Protected Landscape Area (as in many other regions in Europe) thousands of grasslands were destroyed due to intensive farmin in the second half of the last century during the communist era. To improve this, regional seed mixture has been used since 1999 and more than 500 hectares of arable land has been regrassed. The regional seed mixture is aimed to restore Bromion vegetation. It consists of several components – forbs grown in seed beds, grasses *Bromus erectus* and *Festuca rupicola* grown in seed beds and a mixture obtained from the donor sites by a combine harvester and a brush harvester. The establishment of all sown forbs and grasses is successful.

Results of botanical survey show that using of the regional seed mixture with target Bromion species advanced the development of the vegetation to the Bromion vegetation in comparison to commercial seed mixtures or spontaneous succession, which develop more to mezic Arrhenatherion vegetation.

02 - RESTORATION OF SEMI-NATURAL LITTER MEADOWS IN THE ENNS VALLEY

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High nature value farmland (HNVF) areas are valuable resources for the maintenance and promotion of biodiversity. But only a small share of these areas is protected. The restoration and re-introduction of valuable local plant species from available donor sites is therefore seen as being of great political and ecological importance. The main objective of the restoration effort presented lies in the establishment of an ecologically valuable habitat of regional origin. To reach that aim, a careful selection of suitable donor areas of the greatest possible ecological value was a prerequisite. Finally, an evaluation of restoration success with transfer rates of target species and a comparative ordination of donor and receptor sites were undertaken.

The experimental site, located in the central part of Austria (47°56'13" N / 14°19'88" E, 636 m a.s.l), is a mosaic of three different types of Molinion litter meadows: i) a typical litter meadow dominated by *Molinia caerulea*, ii) a meadow dominated by sedges (e.g. *Carex flava*, *Carex leporina*) and iii) a *Iris sibirica* dominated litter meadow. The traditional management is one cut per year at the end of August or beginning of September. The three types of the litter meadow represent the variants of the restoration trial. The distance between donor and receptor site is less than 1 km. For the restoration of Molinion litter meadows with harvested seed mixtures, seeding rates of at least 2-3.5 g m⁻² of threshed material with about 60% pure seeds can be recommended. Due to the high share of frost germinators, the seeding of receptor sites should be undertaken in late autumn. The transfer rate of target species is raising and six years after the establishment it reached about 40 to 50%.

The projective cover of the different species on both donor and receptor site was surveyed according to Schechtner (1958) on plots with 5 x 5 m with three replicates. For data analysis, the statistics language R with the package vegan was used (PCoA for plots, NMDS for species) and showed the following results: Generally, the similarity between donor and receptor site grew with age. Vegetation types in all three variants are closely related, but small differences matter, the dominant factor is a gradient in humidity and nutrients. The success of restoration is decisively influenced by the abiotic conditions; similar conditions facilitate the establishment of similar vegetation types. The conditions on the receptor site decide on success or failure of the restoration efforts.

O3 - RESTORATION OF ALLUVIAL NATURA 2000 GRASSLAND HABITAT BY TOPSOIL REMOVAL AND SPECIES TRANSFER WITH GREEN HAY – RESULTS FROM LONG-TERM MONITORING STUDY OVER 15 YEARS.

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Restoration measures aiming at the recreation of low productive alluvial grassland by topsoil removal and the transfer of various types of seed containing green hay from target communities have been monitored for 15 years between 1998 and 2012. Overall vegetation development during the first four years was characterized by a rapid decline of ruderals followed by a constant and ongoing spread of species transferred with hay. Origin of plant material and flooding frequency as an environmental filter were key factors for the differentiation of vegetation within the restoration site. After 15 years species composition strongly resembled those of the donor sites and up to now only a limited exchange between treatments that received hay from different origin was observed. More than 110 species could establish from the transferred hay, among them numerous endangered target species. Some species, especially sedges, showed a strongly delayed establishment whereas only single species disappeared after successful recruitment. During the second half of the observation period a massive spread of N-fixing legumes such as *Genista tinctoria* and *Ononis spinosa* occurred, reflecting the strong nutrient impoverishment by topsoil removal. Overall, the obtained results approved topsoil removal combined with hay transfer being an extremely successful method for the long-term establishment of species-rich alluvial NATURA 2000 grassland habitats.

O4 - SUCCESSFUL RESTORATION OF MESOPHILOUS GRASSLAND: WHICH FACTORS ARE MOST IMPORTANT? A LONG-YEAR STUDY (2004-2012) OF HAY TRANSFER IN GERMANY

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Between 2004 and 2008 23 measures of hay transfer have been carried out in SW- and NW-Germany, in order to restore or newly create species-rich mesophilous meadows on former arable land or intensively used grassland. In many cases the flora and vegetation of the restored areas were observed by yearly monitoring (species list, permanent plots) over five years (n=14), in some areas over three or four or even seven years (each n=3). We used a great variety of donor meadows, often with Arrhenatherion or Trisetion vegetation and in few cases with Calthion or Mesobromion vegetation, as well as a great variety of areas to be restored.

We assessed the hay transfers by using different parameters, as number of all transferred species and grassland species, transfer rate (%) and Jaccard index, and found (very) great success for 13 areas, medium results for 7 areas and bad results for 3 areas. In any case we consider the following factors as important preconditions for successful restoration: species richness of the donor meadows (at least 20-30 species per plot or 50-60 species per ha), soil opening in stripes or over the whole recipient area by appropriate agricultural machines, appropriate techniques of hay transfer and application, as well as one or two additional cuts after hay transfer in autumn and/or in the following spring.

In our opinion the following three parameters are most important in the restoration of species-rich meadows: (1) Soil water content. We found much better results on fresh or moderately dry soils than on moderately or rather humid, drained soils. Drained peat soils are considered to be very problematic; they have - depending on precipitation and depth of the drainage ditches - high mineralisation rates and with this a large biomass production as well as reduced probability of germination and establishment of the transferred seeds. However, except few floodplain and peat areas, we found no correlation between soil chemical parameters (pH, C/N, P and K content) and the transfer success.

(2) Date of hay transfer. The measure should take place in the first 2(-3) weeks of June (plain meadows) or between mid June and mid July (mountainous meadows). According to our results, (very) high transfer rates are shown by species flowering variably over the season or in early/high summer.

(3) Management of the restoration area in the following months and years, that consists of 1-2 additional cuts after hay transfer and of 1-2 yearly cuts without fertilisation or (in case of acid soils) rare fertilisation with Ca or P/K.

As to summarize, we recommend the hay transfer even on nutrient-rich former arable field or intensively used grassland, being the grassland restoration method that is strongly orientated to ecological aspects, rather cheap and in most cases most effective in relation to other methods.

O5 - INTRODUCTION OF ENDANGERED PLANT SPECIES – EXPERIENCES FROM MEADOWS IN SAXONY

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The majority of meadows in Saxony belong to the mesophytic grasslands (Arrhenatherion, Polygono-Trisetion). In average they composed of only 20.5 different plant species and a high proportion of phytosociological diagnostic species are endangered and rare. Therefore an improved and adapted management is often not sufficient to restore the typical species composition of the meadows and certain species needs individual introduction strategies for a reestablishment.

Here experiences with reintroduction of plant species in mountain habitats as well as in lowland meadows of Saxony are presented. Which pre-conditions are necessary and how the life strategy varies the requirements. The advantages and disadvantages of certain introduction methods are illustrated from our praxis and it is explained why sowing is preferred in most of the cases. The monitoring should base on the population biology and focus on sensitive transitions. Several methods are discussed for that.

A good knowledge of the population biology is the basis of successful reintroductions. When the methods are adapted to the certain species they can be very effective. In our projects initial new populations could be established for species like *Arnica montana*, *Gladiolus imbricatus*, *Phyteuma orbiculare*, *Hypochaeris maculata*, *Dactylorhiza majalis*, *Trifolium spadiceum* and others.

O6 - EVALUATION OF GRASSLAND RESTORATION SUCCESS – A METHOD FOR MULTIPLE PROJECT APPLICATION

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During recent decades restoration of species-rich grasslands with active plant species introduction has been tested and implemented using a great variety of restoration methods either on bare soil or in different species-poor grassland types. In most cases the evaluation of restoration success is exclusively project-specific and the variety of indices and indicators used to evaluate restoration success hampers comparisons between studies.

Since 1993 grasslands of high nature conservation value were established or restored by plant species introduction on several study sites in Saxony-Anhalt. Seeding of site-specific seed mixtures, transfer of green hay or threshing material and their combinations were tested. For lowland hay meadows (habitat type 6510) and alluvial meadows (habitat type 6440) we developed a system to evaluate grassland restoration success independent of donor site, receptor site (bare soil or existing species-poor grassland) and the method for species introduction.

The evaluation tools are in concert with the restoration targets, i.e. an increase of plant species number, the promotion of rare and endangered grassland species as well as typical species composition of habitat types, balance between grasses, herbs and legumes and a high structural diversity. The evaluation is based on three main criteria: i) target species categories, ii) proportion of grasses, herbs and legumes and iii) habitat structure. We defined reproducible rules to attribute all grassland species of the habitat types 6510 and 6440 to different target species categories: i) first-level priority target species, ii) second-level priority target species, iii) common grassland species, iv) species of disturbed sites and v) non-target species. For the classification of species we used e.g. rareness, endangerment and species conservation status, trends in species abundance, index species for habitat types and plant communities, growth form, Ellenbergs nutrient value and sociological groups and Briemles mowing sensitivity. The implementation of the evaluation tools is presented by examples of different restoration sites.

To compare the evaluation results of restored sites with grasslands of good conservation status, we collected several hundred vegetation relevés from different areas in Saxony-Anhalt. However, different scales used for the estimation of plant species cover required an adaptation procedure which will be also presented. After analyzing the vegetation relevés we identified thresholds to categorize restoration success.

Prospectively, the evaluation tools should be adapted and applied to other grassland types, e. g. mountain meadows and mesobromion grasslands.

O7 - HAY TRANSFER, SOWING OF REGIONAL SEED MIXTURES AND THRESHING MATERIAL: RESULTS FROM TRIALS TO ENRICH SPECIES-POOR MEADOWS

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Semi-natural grasslands are hot spots of Europe's biodiversity. However, during the last few decades, land use changes have led to a continuous decline in the area of semi-natural grassland rich in biodiversity. Many grasslands located in Natura 2000 sites have been assessed as being in unfavourable conservation status, thus requiring appropriate restoration measures. Hay transfer is one successful method to restore grasslands using local seed material. However, this method requires a sufficient number of adequate donor sites in the surroundings of restoration sites. Therefore large scale restoration projects often works with sowing of propagated species or threshing material.

To optimize practicability and restoration success, we tested different approaches to enrich the floristic composition of floodplain- and lowland hay meadows (natural habitats 6440, 6510) within a number of Natura 2000 sites in Saxony-Anhalt, Germany. From September 2009 onwards we set up experiments in species-poor

grasslands to introduce target grassland species in strips prepared by rotovating the existing grass swards and afterwards rolling. We used a complete block design with six repetitions and four restoration variants: (1) hay transfer, (2) sowing of threshing material, (3) hay transfer with additional sowing of regional seed mixtures, and (4) threshing material with additional sowing of regional seed mixtures.

Using generalized linear models (GLMs) we detected significant treatment effects on the number and coverage of target grassland species. After two years of vegetation development, we found a higher number of target species in all variants compared with the untreated control. Moreover, additional seeding of regional mixtures further increased species diversity. Thus, our results indicate that near-natural restoration measures are appropriate to quickly re-introduce grassland species. However, we also show that the rise in coverages of introduced forbs is slow while the recovery of remnant grasses is comparably fast. In our talk, we are intending to present and discuss the current results of the project.

O8 - SUCCESSFUL ESTABLISHMENT OF TARGET SPECIES ON A NUTRIENT RICH DEGENERATED HALF-BOG MEADOW

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In the present study target species were introduced into a lowland hay meadow (habitat type 6510) with transition to alluvial meadows of river valleys of the *Cnidion dubii* (habitat type 6440), situated in the Wulfener Bruch area about 40 km north of Halle (Saale, Saxony-Anhalt). The wet meadows in the Wulfener Bruch were drained at the beginning of the 19th century. Because of this and due to fertilization and insufficient mowing, especially in the last few years, the study site developed into a species-poor version of the *Arrhenatheretum elatioris*.

To improve the conservation status of this Natura 2000 grassland species that are character species of the present habitat types, but were not or only in low proportions present, were chosen for introduction. Among the chosen species were 5 grasses, 22 herbs and one legume.

Included in a block experiment with 4 replicates the mixture of the 28 target species of regional origin and propagation was sown in autumn 2011 in stripes prepared by ploughing and grubbing. After introduction the target species stripes were included into the management of the whole block experiment. This means stripes were mowed once, twice or three times a year, had 0, 60 or 120 kg ha⁻¹ urea fertilization and were milled once a year or not.

To evaluate the success of establishment of the target species relevés were made once a year in 2012 and 2013 before the first mowing. The %coverages of all species within 72 plots with 4 m x 4 m size each were estimated as well as the whole vegetation cover. Furthermore seedlings, sterile and fertile individuals of target species were counted within plots of 0,5 m x 0,5 m size, situated in the grand plots. This counting was practiced twice a year.

Whereas the whole vegetation cover in spring 2012 was very low due to ploughing and grubbing, it was about 50 to 90% in spring 2013. In 2012 already 26 of 28 target species were recorded, which means an enrichment of the species pool by 10 target species. Most of the seedlings recorded in spring 2012 were recorded again in autumn 2012 as sterile and in some cases even as fertile individuals. *Geranium pratense* and *Galium album* were the most abundant target species in both years. Effects of different management practices on target species establishment varied. For example plots mowed only once in 2012 had a lower number and coverage of target species in 2013 compared to the plots mowed two or three times.

P1 - METAPLANTATION OF *OSTERICUM PALUSTRE* BESSER FROM INVESTMENT GROUNDS

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Construction works are often serious threat for precious habitats with their species. Metaplantation is one of the possible solutions to protect these rare species.

First decision to use metaplantation as a method of protection to some endangered populations of *Ostericum palustre* in Kujawasko-Pomorskie voivodeship was taken in 2008 and it concerned one of its population in Bydgoszcz surroundings, where road construction plans were appointed (National S5). As a result, 50 specimens of *O. p.* were moved to the new habitat in Bydgoszcz Canal Valley in a distance of approximate 1 km from the original place. Research showed that 56% of the metaplanted individuals were still growing in 2010. Next replantation of *Ostericum palustre* was conducted in Nakło in 2010. Out of 96 plants, 24% of the carried survived till 2012.

In 2011, due to the planned road construction works 153 specimens of the bog angelica were subjected to metaplantation in Nakło region. They were moved to meadow complex 1 km from the original habitat; to the area adjacent to Natura 2000 areas: PHL300004 and PHB300001. 88 of these plants had leave rosette and the rest flowering shots. In 2012 research showed the presence of 126 *Ostericum palustre* specimens. Among them there were plants replanted in their vegetative stage and 38 which have been moved in their generative stage.

Research results prove that bog angelica plants well endure the process subjected to metaplantation, especially if moved in their vegetative stage.

Session - H1 Global change impacts on European heathland ecosystems

Chair: **W. Härdtle**¹

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Heathland ecosystems host a huge proportion of the biodiversity typical of open acidic landscapes in NW Europe. They provide important ecosystem services such as carbon sequestration and clean water, are source of livelihoods and important for recreational purposes. As result of changes in land use practices, the area of heathlands has declined dramatically since the second half of the 19th century. In some countries nearly 90% of the heathlands have disappeared over the last 150 years. Moreover, heaths are also considered susceptible to global change drivers such as climate change and atmospheric pollution (particularly nitrogen). As a consequence, heaths are nowadays regarded as an internationally endangered habitat type of high conservation value, and policy has become more focused on possible measures for the conservation of the remaining heaths.

This session of the conference should address all aspects of current threats to heathland ecosystems, research on global change impacts on heaths and the functioning of heathlands, as well as conceivable management measures that are designed to mitigate or counteract impacts of shifting environmental condition.

O1 - LIFE NATURE FOR HEATHLAND MANAGEMENT AND CONSERVATION: EXAMPLES AND BEST PRACTICES

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The LIFE Programme has been the European Union's funding instrument for the environment since its approval in 1992. It is composed of three strands (LIFE Nature and Biodiversity, LIFE Environment Policy and Governance, and LIFE Information and Communication). Since its establishment 21 years ago, the LIFE Nature and Biodiversity component (formerly LIFE Nature), has co-financed a total of 1.348 projects, providing some € 1.2 billion, and mobilising a further € 1.2 billion in other public and private contributions. This continuous source of targeted financing has radically changed the capacity of many countries and regions to care for and manage Natura 2000 sites.

LIFE project actions are varied and can encompass the development of management plans and other policy documents, support for the enlargement of the Natura 2000 network, improving knowledge of species and habitats, direct conservation actions, capacity building and awareness raising. The results of the first assessment of the conservation status of species and habitats (Article 17 report), which was published in 2010, highlight the importance of LIFE as the sole source of funding for the conservation, restoration and management of certain species and habitats at EU level. Most LIFE projects targeting habitat restoration have resulted in the sites concerned achieving favourable conservation status.

Since the establishment of the LIFE Programme in 1992, approximately 250 projects have directly or indirectly targeted heathland habitats. Around 65% of European heathlands are deemed to be in an unfavourable conservation status, mainly as a result of inadequate management and direct habitat destruction (uncontrolled fires). The main threats to these habitats include poor grazing practices and replacement by commercial forests and other land uses (recreation, urbanisation, etc.). Invasive species (especially alien scrub and trees) and nutrient deposition (mainly atmospheric nitrogen and waste) are also a problem for heathlands.

Lack of good management (balanced grazing and controlled fire) has led to habitats becoming dominated by trees and therefore the most common restoration activity is the removal of trees. Some other examples of project actions on heathland ecosystems include: elimination of alien plants and species, grazing with beef cattle and ponies and, for wet heaths, water level modification. LIFE projects have also aimed to increase public awareness of the value of heathlands, which are often treated as dumping grounds. They carried out school education programmes and involved community groups in monitoring activities. In some cases they introduced fire-prevention measures such as the construction of firebreaks and fences to protect particularly sensitive areas and the employment of wardens throughout the summer period. Land purchase has also been a common action for conserving this type of habitat: areas of heathland have been bought by LIFE projects and added to the Natura 2000 network sites thus ensuring their continued management. While European heathland habitats still have an

unfavourable conservation status, many of the actions taken by LIFE projects have had a significant impact on the conservation status of heathlands on a local and regional level.

This communication will present some examples and best practices from successful LIFE Nature projects targeting heathland management and conservation with the aim of contributing to the active dissemination of the results.

O2 - INTERACTIVE EFFECTS OF IMPORTANT GLOBAL CHANGE DRIVERS ON HEATHLAND ECOSYSTEMS

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Heathland ecosystems host a huge proportion of the biodiversity typical of open acidic landscapes in northwestern Europe. Further, they provide important ecosystem services such as carbon sequestration and clean water, are source of livelihoods and important for recreational purposes. As a result of changes in land use practices, the area of heathlands has declined dramatically since the second half of the 19th century. In recent decades, heaths are subject to global changes such as shifts in climate conditions and atmospheric pollution (particularly nitrogen (N)). Altered precipitation patterns (e.g. summer drought) might affect heathland ecosystems in particular, since their European range is related to a humid climate with moderate summer temperatures and drought events.

Despite recent research on the effects of global change drivers on diversity patterns and the functioning of heathland ecosystems, our knowledge on interactive effects of co-occurring global change drivers is still limited. In principle, ecosystem responses to simultaneous effects of global change drivers (e.g. climate change and N deposition) might be additive (i.e. the summation of single effects) or non-additive (i.e. antagonistic or synergistic interaction). In the latter case, ecosystem responses are often perceived as “ecological surprises”, because they are difficult to predict, and our ability to anticipate and understand them often requires multi-factorial studies with full-factorial combinations of the respective treatments.

This presentation will summarise the most recent findings (of field and greenhouse experiments) on interactive effects of co-occurring global change drivers on the functioning of heathland ecosystems, with a focus on interactive effects of N fertilisation and drought events on plant growth and competition. N fertilisation strongly increased the aboveground biomass allocation of *Calluna vulgaris* plants, resulting in a distinct increase of biomass shoot-root ratios. In addition, we found strong antagonistic interaction effects of N fertilisation and drought for both aboveground and belowground biomass production. $\delta^{13}\text{C}$ values indicated that N fertilisation increased the evaporative demands of *C. vulgaris* plants, likely due to increased biomass shoot-root ratios, which in turn resulted in higher drought susceptibility. Young plants proved to be particularly susceptible to combined effects of N fertilisation and drought, whereas older plants were characterised by low shoot-root ratios and thus responded less susceptible to drought events following N fertilisation. “Central populations” of *C. vulgaris* (northwestern Germany) proved to be more susceptible to drought events compared to plants originating from “rear-edge populations” (northern Spain, eastern Germany).

Our findings indicate that multi-factor analyses may help to better understand and anticipate plant growth responses to co-occurring global change drivers, which in turn might support the guidance of management and conservation efforts aiming at the long-term preservation of European heathland ecosystems.

O3 - EFFECTS OF GLOBAL CHANGE ON PLANT-INSECT AND ABOVE-BELOWGROUND INTERACTIONS IN A DANISH HEATHLAND

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Heathland ecosystems are considered particularly vulnerable to impacts of global change. In particular, climatic changes such as increased drought severity, altered temperature regimes or altered atmospheric CO₂ concentration will likely affect plants and other organisms in heathlands.

Here, we present novel results from a multi-factor climate change experiment on (1) plant-herbivore interactions (Scherber et al. 2013) and (2) above-belowground interactions (Stevnbak et al. 2012). In a split-plot experiment comprising 48 plots, we independently manipulated atmospheric CO₂ concentration, drought and air temperature in a FACE facility ("Climaite" experiment) near Brandbjerg (Denmark). We show that combinations of three climate change drivers may lead to more complex outcomes, potentially affecting predictions of future herbivore impact or soil fertility under climate change.

While elevated CO₂ and drought most strongly affected the observed interactions, we provide evidence that the number of climate change drivers (and not just their identity) affects organism interactions in heathland under future climatic conditions. The consequences of these altered plant-herbivore and above-belowground interactions for the fate of European heathland ecosystems will be discussed.

O4 - EFFECTS OF MONTANE HEATHLAND RESTORATION ON LEAFHOPPERS (AUCHENORRHYNCHA)

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Worldwide land use changes like the expansion of urban areas, intensification of agricultural land and cessation of traditional land use practices are severe threats to biodiversity. Particularly traditional management techniques that are of high importance for the conservation of anthropo-zoogenic grassland and heathland ecosystems are in decline.

In this study, we evaluate the influence of restoration measures on leafhopper (Auchenorrhyncha) communities of montane heathland ecosystems in Central Europe. Our analyses comprised three different treatments: (i) montane heathlands, (ii) restoration sites and (iii) control sites. Montane heathlands had a lower species richness and partially lower density of Auchenorrhyncha in comparison with restoration and control sites. However, they provided important habitats for numerous Auchenorrhyncha specialists whereas restoration and control sites were dominated by generalist species. Contrary to our expectations, we found no differences in species richness and density of Auchenorrhyncha between restoration and control sites. Statistical modelling showed that plant diversity and cover of bare soil were the main predictors of Auchenorrhyncha species richness.

We conclude that restoration measurements might be a useful instrument to promote typical montane heathland Auchenorrhyncha in the long term. However, colonisation is strongly dependent on the establishment of ericaceous dwarf shrubs. In order to increase species richness of heathland specialists on existing montane heathlands the current management should be improved by intensification of the grazing regime. In addition, modest and non-permanent grazing and sod-cutting would create structurally diverse habitats, high plant and microclimatic variability and thus higher diversity of Auchenorrhyncha and arthropods in general.

O5 - NITROGEN AND ACID DEPOSITION INDUCED STOICHIOMETRIC SHIFTS IN HEATHLAND SOILS AND PLANTS: THE MISSING LINK BETWEEN AIR POLLUTION AND FAUNA DECLINE IN HEATHLANDS?

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Emissions of reactive nitrogen and acidifying compounds increased dramatically in the past decades and are still increasing at a global scale. Increased deposition of nitrogen and acids have led to alteration of the biochemical status of the soil and highly increased acidification. The resulting changes are most pronounced in nutrient poor, poorly buffered ecosystems, such as heathland ecosystems. Past research has shown that increased nitrogen deposition leads to a shift in dominance of dwarf shrubs such as *Calluna vulgaris* and *Erica tetralix* towards a dominance of tall grasses, mainly *Molinia caerulea* and *Deschampsia flexuosa*. Soil acidification is the major cause for the extinction of populations of characteristic herbaceous plant species such as *Arnica Montana*.

In parallel, the faunistic diversity of heathlands has declined considerably as well. Until now, the causal mechanism behind the faunistic biodiversity decline has been ascribed to changes in environmental characteristics, for instance, the effects of alterations in vegetation structure and microclimate due to grass-encroachment by *Molinia caerulea*. Surprisingly, hardly any research focused on the effects of the altered biochemical status of heathlands. As soil nutrient ratios change, so do plant nutrient ratios due to altered species assemblages as well as altered intraspecific element ratios.

Heterotrophs have to overcome large differences in element ratios of autotrophs in respect to their own elemental ratio. As heathlands are naturally nutrient poor and imbalanced environments, stoichiometric constraint naturally plays a major role in the structure and functioning of heathland fauna communities and is likely to increase in importance as heathlands become degraded. As eutrophication and acidification further enhance these plant nutritional imbalances, increased stoichiometric constraint could therefore be a major cause of the decline of characteristic heathland fauna.

We studied stoichiometric shifts in heathlands in relation to degradation processes such as eutrophication and acidification as well as nature conservation practices, such as sod cutting. We conducted field and laboratory studies on soil and plant chemistry and occurrences and life history of a wide variety of animal species. Herbivore invertebrates show negative response to increased plant N:P ratios and low magnesium concentration in plants. As a result, invertebrate prey availability for chicks of Black Grouse in the near extinct remnant population has dropped below the known threshold level. Sand lizards show signs of calcium deficiency in heathland populations compared to (calcium rich) dune populations. Field crickets in a laboratory experiment show a sharp decrease in fecundity when fed with plants with high N:P ratio. These finds are of high relevance for both policy makers and managers of nutrient poor ecosystems and stress the need to reduce anthropogenic emissions.

Session OL 1 - The role of megaherbivores for open landscapes in Europe

Chairs: R. Krawczynski¹, H.-G. Wagner¹ & G. Wiegleb¹

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Herbivory in the way of grazing and browsing of large mammals is one of the most influential processes in forming habitats. The role of large herbivores in reducing woodland cover and maintaining open habitats has been long acknowledged and is a dread to forestry. However, what do we know about species composition and density in European landscapes without the influence of early men? Which species would form the potential European megafauna and for how long could they resist extinction? And what consequences do these insights have for biodiversity conservation?

This session will incorporate results from palaeontological, historical and ecological studies. We welcome contributions that focus on theoretically aspects as well as contributions that discuss the use of large herbivores as a tool for nature conservation.

Session OL2 - Rewilding as tool and target in the management of open landscapes

Chairs: R. Ejrnæs¹ & C. Fløjgaard¹

¹Aarhus University, Rønde, Denmark

“Wilderness without animals is dead—dead scenery. Animals without wilderness are a closed book” (wildlife cinematographer Lois Crisler).

From reintroducing large predators for top-down management of large-scale ecosystems in North America to heck cattle and konik horses in semi-natural areas of Europe - rewilding is gaining traction! Private funds and fiery souls are taking the lead in rewilding while scientists and policy makers are struggling to keep up. Historical losses of mammals and birds are being replaced, either on purpose or by spontaneous migration. And there are plenty of unresolved questions ahead, including: what is a solid faunistic baseline? What was lost when the animals went and what will return if we bring them back? Is rewilding an attractive alternative to traditional management for conservation? What are relevant criteria and targets for new introductions? How will re-introduced animals interact with the other drivers and pressures in ecosystems? How do we handle the conflicts between humans and large animals?

In this session we encourage contributions covering both hands-on studies of ongoing rewilding cases in Europe and North America as well as presentations focusing on the scientific theory underlying the argument for rewilding. The aim is a constructive debate and exchange of ideas and experiences across countries and continents.

Session OL1 and OL2 will take place as joint session OL1/2

O1 - OPEN LANDSCAPES IN EUROPE: THE ROLE OF MEGAHERBIVORES

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In general, the natural potential vegetation of Europe is seen as a closed forest, which is in most cases, dominated by European beech. Another possibility is that large herbivores might have played a dominant role in creating the landscape in Central Europe if they would not have been extinct. According to the megaherbivore theory, the landscape of Central Europe would be dominated by half-open landscapes and not by a closed forest. This talk will open the discussion how “natural” open and half-open habitats are in Europe and which role the potential European megafauna could have played. We will discuss how large herbivores are used today in nature conservation and on which goals nature conservation should focus.

O2 - WATER BUFFALOS IN BIODIVERSITY CONSERVATION

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In recent years, a holistic approach to biodiversity conservation has proved successful: Large grazers like cattle, horse and bison have been used to fill the missing niche of large herbivores in many areas in Europe and to great success. However, these grazers come to their limits in some wetlands. Therefore water buffalos have been introduced in some areas to stop the encroachment of dominant plant species in formerly or still species rich areas. Buffalos can digest plants like rush, which is not digestible for cattle or horses. They maintain open waters by grazing and wallowing, benefitting amphibians and wading birds. Despite the common believe, water buffalos have been part of the Holocene fauna of Europe which is indicated by rock carvings and subfossil bones. So they are perfectly fit for year round grazing and grow a thick winter coat, withstanding temperatures well below -20° C. The presentation will give examples on the successful use of buffalos in biodiversity conservation.

O3 - THE IMPORTANCE OF SCAVENGER COMMUNITIES IN OPEN LANDSCAPES

D. Bautze¹, X. Gu¹, R. Krawczynski¹ & G. Wiegleb¹

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Few synoptic studies on carrion ecology for Central Europe have been carried out so far. Generally, the focus is on woodland, insects of forensic relevance and their successional patterns. Vertebrate scavengers are usually excluded from the experimental design. For a broader insight into carrion ecology, carcasses of road kills (deer, boar) were placed in an open area in east Brandenburg (Germany). The results of this five years study provide information on which species uses large vertebrate carcasses in what way.

Phytophagous insects like bees, butterflies or grasshoppers were feeding directly from the carcasses. Other scavengers like Blue Tit or Wild Boar show a strong seasonality in the utilization of carcasses. In contrast to carcasses placed in surrounding woodland, species richness of insects and birds was much higher in the open area. Potential vertebrate scavengers which were not found in the open area were Pine Marten and Green Woodpecker. However, the condition of a carcass at the initial stage, its size and the season strongly influence the decomposition process and the composition of the scavenger community at each carcass.

O4 - DIVERSITY COMPONENTS OF 14000-YEAR PALYNOLOGICAL RECORD – RICHNESS, EVENNESS AND PHYLOGENETIC DIVERSITY – IN RELATION TO LANDSCAPE OPENNESS

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In the boreonemoral zone, landscape openness is mainly related to human activities at present day and these open semi-natural areas are regarded as hotspots of biodiversity. In central and northern Europe, agriculture became wide-scale 6000-4000 years ago. Long time perspective is, therefore, needed to study the formation of the high diversity of European semi-natural landscapes. Palynological (based on sedimentary pollen data) record provides an insight into vegetation change over several millennia. While palynological richness and evenness have been relatively widely used to characterize the changes in past biodiversity, phylogenetic diversity is a novel way of characterizing palynological diversity.

We used 1033 pollen samples from 21 published datasets from Estonia and Latvia ranging from 14000 cal. years BP (calibrated years before 1950) to present day to calculate palynological richness, evenness, phylogenetic diversity, landscape openness and proportion of cultivated land. We evaluated our method of calculating

"palynological phylogenetic diversity" with a simulation study that confirmed that pollen-based phylogenetic diversity can be used to predict actual community phylogenetic diversity. Evenness, landscape openness and proportion of cultivated land were calculated with the help of landscape reconstruction model that "translates" pollen counts into vegetation proportions. We then compared the development of different diversity components through time from Late Glacial period until the present day in relation to landscape openness and proportion of cultivated land.

The maximum values of palynological richness were observed in the samples from last 500 years and considerable increase in richness began already 4000 cal. years BP. In contrast, the phylogenetic diversity had its maximum values in the Late Glacial period and decreased throughout the 14000-year study period. Pollen evenness had its highest values in the Late Glacial but peaked also in the middle of the Holocene around 6000-7000 cal. years. BP.

The continuous increase of palynological richness during the last 4000 years can be assumed to be related to humans creating additional open habitats, introducing grazing animals thereby improving dispersal possibilities, and introducing new plant taxa. The increase in palynological richness was, however, accompanied by a decrease in phylogenetic diversity indicating that the traits of taxa that are related to human-influenced habitats are phylogenetically clustered and humans have therefore "selected" for phylogenetically more similar taxa.

O5 - WHAT DO THEY EAT? USING DNA BARCODING TO ASSESS DIET PREFERENCES OF DEER

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Humans have modified most ecosystems on Earth to a degree where even the largest "wild" nature reserves need management to avoid the loss of biodiversity. Native large herbivore grazing has potential as an efficient and natural tool in this management because they create dynamics and keep landscapes open. However, in order to use this tool properly, we need to know more about what the animals eat compared to what is available in different habitats and how access to supplementary fodder influences the grazing effect on the vegetation. Using DNA barcoding of feces, we are investigating the diet preferences of deer (red deer and roe deer) in Klelund Deer Park in Denmark. Over one year, we collect feces samples every month from different habitat types (e.g., heath, marsh, meadow, open forests and coniferous plantation) within the park. DNA barcoding can not only tell us which plants are consumed but also in which proportions. We intend to uncover the variation in deer diet over a year and among different habitats and how supplementary fodder influences the diet preference. The results will contribute to a better understanding of deer management as well as how deer grazing can be used as a tool in management of open landscapes.

O6 - CATTLE FORAGING HABITS BENEFIT VEGETATION STRUCTURE DIVERSITY AND ORTHOPTERA UNDER YEAR-ROUND GRAZING

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Year-round grazing with robust cattle is increasingly used as a near-natural tool for the restoration of structurally diverse grassland ecosystems in Western and Central Europe. We investigated the success of several German year-round grazing projects and analyzed the interplay between emerging vegetation structures, grazing patterns and abiotic environmental conditions. Vegetation composition, aboveground biomass and soil properties as well as Orthoptera were sampled at 10 year-round grazed sites and conventionally managed control sites in Northwestern Germany. At two sites, cattle foraging patterns were studied using GPS-logger. For plot selection, we predefined structural vegetation types and later statistically determined indicative plant species for each structural type. Our data clearly demonstrate a positive feedback between grazing intensity and fodder quality. Cattle adopt their grazing habits to seasonally changing biomass quality and supply leading to a patchy

vegetation structure of intensively grazed swards and less frequented areas dominated by high growing grasses and tall forbs. The high structure diversity leads to a high diversity, but plant species number at plot scale did not differ between year-round and conventionally grazed sites. Orthoptera species number was also similar for all management types. However, their density was significantly higher in year-round grazed than in conventionally managed sites in late summer. Summing up we evaluate year-round grazing as a useful management for the conservation of plant and insect diversity of large grassland areas.

O7 - REWILDING STATUS IN DENMARK

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Rewilding projects are increasingly being planned and implemented throughout North America and Europe, including Denmark, in the attempt to reintroduce missing predators and herbivores for protecting or restoring habitats, endangered species, or missing ecological functions in the ecosystem. In Denmark, bison projects are established on the island of Bornholm by the Nature Agency and in the meadows of Vorup in Jutland by Randers Rainforest and Aage V. Jensens Naturfond. These are well-known projects as well as the feral horse project on the island of Langeland founded by the Nature Agency.

Apart from these known projects, what is the current status of rewilding projects in Denmark? No overview has hitherto been made. To remedy this, we surveyed rewilding projects by contacting all public nature managing entities in the country: 98 municipalities and 22 nature agencies. In parallel, we investigated the attitude towards rewilding as a management tool in nature management among nature managers including researchers, NGOs, private nature consultancies, and public nature managers. Respondents to the questionnaire were participants at two national biodiversity and nature conferences in December 2012 (“Evidence-based nature management”) and in April 2013 (“Biodiversity symposium”).

Mapping of rewilding projects based on answers from 75% of the public nature managing entities showed that rewilding projects have already been initiated in 18 municipalities and 6 nature agencies and additional 7 municipalities are planning to execute rewilding projects within the next 5 years. The spatial distribution of these rewilding projects was uniform across the country and accounted for private rewilding projects in 10 municipalities and public rewilding projects in 19 municipalities.

Results from the questionnaire based on answers from 70% of the 150 respondents revealed that 90% of the respondents were familiar with the term “rewilding” and approximately 90% of these were in favor of implementing rewilding as a management tool in nature management. 50% of the respondents considered it likely to include rewilding projects in their current work. The respondents clearly stated that lack of land was the main challenge for implementation of rewilding, while pointing towards the Danish National Parks and NATURA 2000 areas as potential rewilding areas.

Conclusively, as the numbers of ongoing rewilding projects are rapidly growing in Denmark there is an increasing need for researchers to evaluate these projects to ensure future successful implementation of rewilding in Danish nature management.

O8 - Creating dry meadow habitats to support the diversity of pollinating insects in urban regions

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Dry meadow habitats have been in decline in Finland throughout the 20th century, as they have in much of Europe. Many vascular plants and insect taxa associated with dry meadows have become threatened as a result, giving rise to concerns over the provision of the ecosystem service of pollination. Urban regions contain a variety of natural and semi-natural habitats with nectar-bearing vascular plants. The Helsinki Meadows project conducted

surveys of a number of insect taxa and vascular plants of mesic and dry meadow habitats in the capital region during 2006-2010. In 2011, the landfill meadows project was established to create novel dry meadow habitats on landfill hills. The objective of this project is to create urban recreational areas in which the public can become familiar with meadow ecosystems, as well as the supplementation of dry meadow habitats for the enhancement of biodiversity and the provision of the ecosystem service of pollination. Provisional results suggest that urban meadows maintain species diversity of vascular plants, carabid beetles and spiders, though assemblages of butterflies are species poor. Urban meadow networks also support diverse assemblages of bees, though there are as yet no records of threatened species. My studies support suggestions that habitat fragmentation, isolation and the high contrast of habitat edges restrict the diversity of highly motile insect taxa in urban landscapes. I conclude that strategies for the enhancement of urban biodiversity should focus on the landscape or beta level rather than the currently prevalent site or alpha level.

Session OL3 - Global change and nature conservation of open landscapes

Chairs: T. Fartmann¹, G. Stuhldreher² & B. Baur³

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Global change (climate shift, landscape modification, fragmentation) is accelerating at an unprecedented pace. Alterations in land-use practices and fragmentation of landscapes have the most visible effects on ecosystems, and probably represent the dominant threat to biodiversity. This is paralleled by rising temperatures, imposing additional stress on the biota and forcing plant and animal species to migrate to higher latitudes/altitudes or to adapt to changing conditions in situ.

The aim of the session is to present global change-related research that improves our understanding of the processes affecting biodiversity of open landscapes and that increases our knowledge on how to translate research findings into management strategies suited to mitigate and counteract perceived threats to biodiversity.

O1 - WATER BALANCE OF *KOBRESIA PYGMAEA* PASTURES UNDER THE EFFECTS OF CLIMATE CHANGE

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The *Kobresia pygmaea* pastures are the world's largest 'alpine' ecosystem extending over 450 000 km² in the south-eastern Tibetan highlands. These pastures are subject to rapid land use and climate change, the most prominent issues are effects on ecosystem services, especially (aboveground) biomass productivity and carbon sequestration / emission. Land use changes, i.e. grazing intensification, lead to degradation of the vegetation. Effects of global climate change on the plateau will most likely be high rates of temperature change and changes in seasonal precipitation patterns. Due to the Tibetan Plateau's important role for the global climate as the "third pole" and its importance as grazing pastures for the population, research in this fragile ecosystem is essential for future attempts to protect and stabilise it.

The present research project is part of the Atmosphere-Ecology-Glaciology Cluster within the DFG SPP 1372 "TiP- Tibetan Plateau: Formation-Climate-Ecosystems". Aim of the research project is to measure the effects of degradation and climate change on the water balance of the *Kobresia pygmaea* vegetation. In detail, the influence of (i) different grazing treatments (degradation), (ii) water- and (iii) nutrient availability, as well as changes in (iv) temperature on the water balance (evapotranspiration and infiltration), biomass growth and photosynthesis rates of the *Kobresia* vegetation are investigated.

Field site of the project is since 2009 the Kema Research station (4410 m a.s.l., 270 km NE of Lhasa; TAR, PR China), located in the centre of the major distribution of the *Kobresia pygmaea* pastures of the Tibetan Plateau. The study plot consist of subplots with different grazing treatments. In 2010 and 2012, a total of 82 so-called lysimeters (= an intact soil column with vegetation cover inside a Plexiglas tube; with fibre wicks at bottom to collect infiltration water in a bottle) were installed to monitor the water balance of the *Kobresia* vegetation. In addition, an irrigation manipulation experiment was set up in 2012, whereat gutter roofs generating three different irrigation levels (100%/control, 70% and 130% of natural precipitation) were placed above lysimeters. In this experiment, fertilised and unfertilised *Kobresia* vegetation plots under the different irrigation levels were monitored.

In the years 2010, 2011 and 2012, data on evapotranspiration, infiltration and biomass growth of *Kobresia pygmaea* pastures was collected.

First results indicate a general trend which shows that evapotranspiration and infiltration of the *Kobresia* pastures depend strongly on the amount of water (precipitation, irrigation) available. So far, no strong difference in evapotranspiration rates between fertilised and unfertilised plots was found. The different grazing treatments seem to have no effect on the water balance of the vegetation.

Data on photosynthesis rates as well as effects of changes in soil temperature on the water balance are expected for summer 2013.

O2 - EFFECTS OF SOIL AND TOPOGRAPHY ON SUCCESSION OF HEATHLAND PLANT COMMUNITIES

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Heathlands are in Europe protected by the EU Habitats Directive. However, they are still threatened by various changes, including abandonment of land use leading to succession. Here we assess changes in forest cover in the Fontainebleau forest (Central France) between 1946 and 2003 and we examine the effects of soil (soil types and depth) and topography parameters on heathland stability and dynamics of woody plant species during this period. During 1946-2003 forest areas increased by 60% at the expense of heathlands. Over the last 20 years of our study period coniferous tree species colonized heathlands much faster than deciduous trees. In general, succession speed was much faster on north-facing sites and sites with brown calcareous earth. In contrast, heathland stability was high on shallow soils and on flat or south-facing sites.

Our study will help land managers to select heathlands with environmental conditions that prevent reforestation, and hence, which favour the long-term stability of heathlands for conservation or restoration.

O3 - WHEN HABITAT MANAGEMENT CAN BE A BAD THING – THE HABITAT PREFERENCES OF THE WOODLAND RINGLET (*EREBIA MEDUSA*) IN CENTRAL GERMANY

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The survival of many habitat specialists of nutrient-poor grasslands depends on extensive forms of land-use. Some grassland species, however, are negatively affected by grazing or mowing, and thereby cause a management dilemma. One of these species is the Woodland Ringlet butterfly (*Erebia medusa*).

In this study we analyzed which environmental factors determine the distribution of *E. medusa* in the Diemel Valley in Central Germany. Furthermore, we conducted microclimatic measurements in occupied habitat patches during the winter months to investigate the role of the litter layer as a microclimatic buffer.

Patch occupancy was significantly related to the absence of grazing or mowing, the amount of litter and the connectivity to other inhabited patches. During the winter, the air temperature inside the litter layer was significantly higher than above, and at the same time significantly less variable.

We conclude that the apparent sensitivity of *E. medusa* to any kind of land-use is probably due to direct damages to the eggs and larvae as well as to the buffering effect of thick layers of litter. Hence the conservation of *E. medusa* requires a very careful habitat management, for example by rotational grazing or mowing of small parts of the sites.

O4 - MODELLING THE SPATIAL DISTRIBUTION OF SPECIES-RICH FARMLAND TO IDENTIFY PRIORITY AREAS FOR CONSERVATION ACTIONS AT REGIONAL SCALES IN GERMANY

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Farmland in Europe occupies about half of the available land area and a substantial proportion of the wildlife is associated with that land and depends on regular agricultural management. Over the last decades two contrasting processes have altered agricultural landscapes: agricultural intensification and specialisation has led to simplified landscapes in high productive landscapes and abandonment of agricultural production took place in low productivity landscapes when management fell below economic profitability. Both, abandonment and intensification have resulted in the loss of farmland biodiversity.

Agri-environment schemes (AES) are implemented to counteract declines in biodiversity. To optimise the effectiveness of conservation initiatives, AES should be tailored at regional scales depending on the species inventory, the productivity of the landscape and societal demands. In high productive landscapes AES might be effective outside production units (e.g. wildflower strips) to sustain a certain level of biodiversity and ecosystem services. In contrast, in marginal landscapes, where levels of biodiversity are usually high, AES should focus on sustaining low-intensity farming systems and keeping the farmer in business. However, to facilitate such spatial targeting of conservation efforts, methods are urgently needed for identifying hotspots of species-rich farmland, where low-intensity farming should be maintained.

Here, we aim at modelling the spatial distribution of species-rich farmland and landscape elements at a national scale in Germany. Based on data describing the distribution of species-rich farmland and landscape elements within 915 1-km² sample plots across Germany, we gathered data on climate, topography, landscape, soil, agriculture and human population. Using Factor analysis and mixed effect models, we provide an understanding of the possible underlying factors that have led to the current distribution of species-rich farmland and landscape elements within the sample plots. Species-rich farmland was positively associated with low-input grassland farming and decreased with increasing livestock units of intensive husbandry and percentage cover of arable land. Landscape elements were positively related to edge density and negatively related with intensive livestock farming and topography. In the next step, we used these models to predict the distribution of species-rich farmland and landscape elements at a national scale with a spatial resolution of 1 km. The maps for Germany show different clusters of areas with high percentage of species-rich farmland and landscape elements, respectively.

This modelling approach helps to identify priority regions for conservation of farmland biodiversity. In a policy context, the generated maps could be used as a tool to inform and guide strategic planning in farmland biodiversity conservation actions to prevent further intensification and/or abandonment of agriculture in these particular regions.

O5 - PREDICTION OF PRESENCE AND ABSENCE OF INSECT SPECIES FROM LAND COVER AND CLIMATIC DATA USING AN ADAPTIVE NEURO FUZZY INFERENCE SYSTEM (ANFIS) MODEL

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The population dynamics of insects is highly affected by climate, therefore effective prediction of species distribution using climatic and environmental data is important in agricultural and environmental ecology. Two artificial intelligence approaches employed to predict distribution of 5 insect species from climatic and land cover data and compared with a conventional statistical approach (stepwise regression). Neuro-Fuzzy Interface System (ANFIS) was used to predict insect distribution from 5 climatic and landcover variables, while Artificial Neural Networks (ANN) model was able to handle much more variables as inputs. In this study ANFIS system was used to predict presence versus absence of insects from given environmental and ecological variables as input to the model. Based on training data, we were able to obtain the proper outputs for each selected inputs. We found the ANFIS model to be highly effective in predicting distribution with a limited number of predictors, having a range of 86–99.5% correct predictions. In comparison with statistical models that depend completely on the availability and quality of insect distribution data and uses lots of input variables, our model was able to predict the present/absence with high performance using limited number of inputs. Predictions are in county level which gives the resolution needed for local ecological management and can be utilized for planning biological control practices and preventive invasion of non-native pest into a new area.

O6 - SURVIVAL IN FRAGMENTED LANDSCAPES: THE ROLE OF FUNCTIONAL CONNECTIVITY FOR PATCH OCCUPANCY IN GRASSLAND SPECIALISTS

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Habitat specialists living in metapopulations are sensitive to environmental changes such as habitat fragmentation. In most studies, the effects of fragmentation on such species are analysed based on Euclidean inter-patch distances. This approach, however, ignores the role of the landscape matrix. Recently, therefore, functional distances that account for the composition of the landscape surrounding habitat patches have been used more frequently. However, the predictive power of functional and non-functional connectivity for patch occupancy by habitat specialists has never been compared in a multi-species approach.

In this study we evaluated the effect of the landscape matrix on the distribution of 13 habitat specialists from three different insect orders in fragmented calcareous grasslands. We modelled species' occurrence using the classical approach (based on Euclidean inter-patch distances) on the one hand and the functional approach (based on least-cost modelling) on the other hand. We tested three different sets of resistance values and rankings for the functional approach. In each case, habitat connectivity was calculated using Hanski's index.

We found that each of the functional connectivity measures provided better results than the non-functional approach. In addition, isolation effects were only detected in some species when functional rather than Euclidean distances were used.

In order to take into account possible effects of the landscape matrix on patch occupancy by habitat specialists, future metapopulation studies should use functional rather than Euclidean distances whenever possible. However, it is important to note that detailed land-cover data is not always available. For practical applications we therefore recommend a 'simple approach', which provided results that were almost as good as our best but much more complex connectivity measure, even though it only separated the landscape matrix in open land and woody areas. Such coarse data are easier to obtain and analyse than detailed maps containing different types of land-cover.

O7 - MOLEHILLS AS IMPORTANT LARVAL HABITATS FOR THE GRIZZLED SKIPPER (*PYRGUS MALVAE*) IN CALCAREOUS GRASSLANDS

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As a consequence of land use change, including the abandonment of semi-natural grasslands, small-scale soil disturbances, such as animal mounds created by subterranean ecosystem engineers function as important refuge habitats for species of conservation concern, as low-competitive plant species. Such sites may differ from the surrounding matrix vegetation in terms of vegetation structure, microclimate or soil conditions. The effects of ecosystem engineers on plant species diversity and soil properties have been extensively studied. On the contrary, knowledge on the influence of engineering organisms on other taxa, such as insects, is still rare.

In this study, we demonstrate what role hills of the European Mole (*Talpa europaea*) (Linnaeus, 1758) play as a larval habitat for a threatened butterfly species within central European calcareous grasslands. We selected the Grizzled Skipper (*Pyrgus malvae*) (Linnaeus, 1758) as a study species as prior studies observed that it prefers warm and open microhabitats for oviposition.

Our study clearly showed that host plants occurring on or in the close vicinity of molehills were regularly occupied by immature stages of *P. malvae*. Occupied host plants at these disturbed sites were characterized by a more open vegetation structure with a higher proportion of bare ground or stones and a lower cover of the herb layer compared with available host plants (control samples). Among molehills those were preferred that had the highest cover of host plants, especially *Agrimonia eupatoria*.

Molehills are important larval habitats for *P. malvae* in calcareous grasslands on deeper soils. On these sites successional speed is high and the amount of bare ground usually low, even when they are managed. In contrast to other known breeding sites in calcareous grasslands, molehills with a higher cover of host plants combine both essential requirements for a successful larval development of *P. malvae*: (i) sufficient food during the larval period and (ii) warm microclimatic conditions.

(Streitberger, M. & T. Fartmann (in press): Molehills as important larval habitats for the Grizzled Skipper (*Pyrgus malvae*) in calcareous grasslands. *European Journal of Entomology*)

P1 - EUROPEAN SEMI-NATURAL GRASSLANDS UNDER THE TRIPLE THREAT OF LAND-USE CHANGE, CLIMATE CHANGE AND BIOTIC INVASIONS: THE BIODIVERSA PROJECT SIGNAL

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Semi-natural grasslands are a prominent feature of European cultural landscapes. They have evolved under millennia of low-intensity human land use, host a very high fraction of the continent's biodiversity and play a key role in agricultural production. Like all other ecosystems, they are recently facing the multiple threats of anthropogenic global change. In the newly started BiodivERsA research project SIGNAL, an international team of researchers, including many EDGG members, is trying to analyse how three major components of global change affect European semi-natural grasslands, namely climate change, land use change and biotic invasions. This triple threat is exemplified by extreme droughts (statistical 1000-yr recurrence), gradient of land use intensity (cutting height 3 cm, 10 cm and abandonment) and neophyte invasion (*Lupinus polyphyllus* as a legume and *Senecio inaequidens* as a non-legume forb). The effects of these factors on biodiversity and ecosystem functions and services is assessed in a fully factorial design in a field experiment across ten countries along an climate gradient from Belgium and France to Turkey and Israel as well as a mesocosm experiment involving most of the same countries. Further, we ask whether certain components of biodiversity (species diversity, intraspecific diversity and functional diversity) might make grasslands more resilient against negative effects of drought, intensified management or biotic invasion. SIGNAL aims at extrapolating the experimental findings to the European semi-natural grasslands in general by use of vegetation databases, which will be brought together on a single platform (European Grassland Archive, EGA), remote sensing and GIS modelling and at making the results applicable in agriculture and land-use management through intensive stakeholder contacts. In our contribution, we will present the concept of SIGNAL and the underlying hypotheses as well as the present stage of experiments and possibilities to get involved in the stakeholder process.

P2 – HISTORICAL MAPPING OF ECOSYSTEM SERVICES IN THE VILLAR D'ARÈNE, FRENCH ALPS

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Since 2003 field measurements of (i) plant traits of abundant plants and (ii) environmental parameters were conducted for the village of Villar d'Arène in the French Alps. Additionally, maps of land use and environmental conditions are available for Villar d'Arène.

Using Generalized Linear Models we assessed the variation of (i) functional traits of plants (community weighted mean and functional divergence), and (ii) ecosystem properties across the landscape. Moreover, as ecosystem properties underlie ecosystem services, several ecosystem services were estimated from ecosystem properties, taking into account how stakeholders valued them. These models were then used to calculate ecosystem services for each 20 × 20 m pixel and so we obtained maps of ecosystem services for the Villar d'Arène. This work was done for current conditions and is still in progress for past land uses.

P3 - PLANT INVASIONS AS A THREAT TO BIODIVERSITY OF OPEN LANDSCAPES – A LARGE-SCALE STUDY ON *SOLIDAGO* SPECIES IN SOUTH-WESTERN POLAND

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The invasion of alien plant species in natural and semi-natural habitats is a serious problem influencing structure and dynamics of ecosystems including the decrease of biodiversity. Competitive alien plant species are able to colonize new plant communities and to replace native species. Competition is an important factor shaping the structure of plant communities and influencing species distribution.

Species from genus *Solidago* are worldwide exceptionally successful invaders from North America. Among about 120 *Solidago* species, known from their native range, four are invaders, which so far have conquered Europe, large parts of Asia, Australia and New Zealand. In central Europe five representatives of the *Solidago* genus are found. Only one species, the common goldenrod (*S. virgaurea* L.), is native for Europe, while the other four are of American origin, namely: smooth goldenrod (*S. gigantea* Aiton), Canadian goldenrod (*S. canadensis* L.), late goldenrod (*S. altissima* L. - *S. canadensis* var. *scabra* (Muhl.) Torr. and Gray) and grass-leaved goldenrod (*S. graminifolia* (L.) Elliot). All these species occur in south-western Poland.

Distribution of the particular *Solidago* taxa was surveyed on the basis of a 10 × 10 km grid, covering ca. 30,000 ha. The nearest patches with occurrence of goldenrods placed to the nodes were selected for sampling. Per sampled patch land use type as well as species composition and cover in 10 × 10 m plots were ascertained. Species richness and Shannon-Wiener diversity index were correlated with the cover of *Solidago* in order to examine their effect on biodiversity. The distribution of particular *Solidago* taxa was mapped and their spatial structures were assessed. The data of land use type was used to determine their habitat preferences. The most numerous goldenrod species in south-western Poland were *Solidago altissima* and *S. gigantea* (116 and 125 occupied plots, respectively). The two species did not differ significantly with respect to their habitat preferences. The distribution of both species was clumped. Plant species diversity and Shannon-Wiener diversity index significantly decreased with increased cover of invasive goldenrods.

P4 - ECOSYSTEM FUNCTIONS OF STEPPE LANDSCAPES NEAR LAKE BAIKAL

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Steppe grasslands are open habitats that are widespread in continental Eurasia. The steppe landscapes of Priol'khon at the Lake Baikal (southern Siberia, Russia) were investigated in this study. The steppe grasslands of this region are mainly stony occurring on gentle slopes with *Festuca* spp. and *Poa* spp. or with tallgrass and *Stipa* spp. on chestnut or soddy shallow soils, which in some places gradually change to forest steppe. The problem of estimation of ecosystem services and study of ecosystem functions are inter-related issues. The quantity and quality of ecosystem services depend on the function of an ecosystem. Separate ecosystem service is a product of two or more ecosystem functions, whereas in other cases a separate ecosystem function makes a contribution to two or more ecosystem services. Landscapes surrounding Lake Baikal carry out functions of phytomass production, water protection and environment-forming. They have a great importance for the preservation of the unique ecosystem of Lake Baikal. The production and accumulation of phytomass is one of the most important ecosystem functions. It is the main indicator of productivity, which can serve as a measure for the economic value of an ecosystem. Water protection functions depend on the hydrological cycle parameters. It is one of the main landscape functions. The major components of hydrological cycle in landscapes are drainage, percolation and evaporation processes.

Our research purpose is the estimation and mapping of the ecosystem functions of the steppe landscape surrounding Lake Baikal. Our study includes the following tasks: (i) Phytomass stock calculation of herbaceous vegetation in the steppe ecosystem. (ii) Assessment and modeling of the ecosystem regulation function of rain and snowmelt water flow. (iii): Calculation of the maximum and average percolation values depending on the

ecosystem characteristics by field experiments. (iv): Creation of an ecosystem classification of the Priol'khon region.

The study area is used for agriculture and recreation. However, fishing and nature conservation activities also play an important role. As the landscape satisfies different human demands there are many land-management conflicts. In recent years, the intensity of recreational activity has increased significantly. The attractiveness of Priol'khon region consists in a special micro-climate, landscape diversity and the picturesque of nature for tourists. There is also a large amount of sunny days per year. The data obtained within research allow defining priorities in land use and conflict resolution. Recent studies show a strong transformation of the landscape associated with a total or partial loss of ecosystem services (e.g. the loss of biodiversity, the reduction of phytomass production, water percolation reduces, etc.).

Session N1 - Nutrient deposition into open landscapes

Chairs: **V. Minden¹ & C. Peppler-Lisbach¹**

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Today's ecosystems are subject to increased nutrient deposition due to e.g. burning of fossil fuels and extended usage of fertilizer. Especially nitrogen and phosphorus deposition rates have increased significantly due to atmospheric relocation and run-off from agricultural lands. Shifts in nutrient regimes might have profound effects on natural systems, by for example facilitating occurrence of competitively stronger species, resulting in a shift in species composition leading to a loss a biodiversity in many ecosystems.

This session aims to encourage contributions about the effects of nutrient inputs into open landscapes. Contributions on ecological stoichiometry, biodiversity, ecosystem services/functions are especially encouraged, as well as on management concepts and restoration of degraded ecosystems.

O1 - RELATIONSHIPS BETWEEN PLANT TRAITS: A COMPARISON OF STOICHIOMETRIC, PLANT ALLOCATION-, SIZE- AND MORPHOLOGY-RELATED TRAITS OF PLANT SPECIES OF A GERMAN SALT MARSH

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Processing of plant material to produce data on element contents is laborious and consumes both time and money. Other plant traits like biomass allocation traits or SLA are more easy to measure and some have been shown to be well suited as 'substitute-traits' for those hard to quantify.

In my presentation I give an overview about different types of plant traits and their relationships to each other. Using a dataset on salt marshes of NW-Germany, I show which e.g. plant allometry traits are highly correlated to stoichiometric traits and which are not, and give reasons for these patterns. I conclude with relationships that need further research in the future.

O2 - HABITAT REQUIREMENTS OF THE ENDANGERED ORCHID *LIPARIS LOESELII* IN DANISH RICH FENS

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Liparis loeselii is included at the appendix IV in the European Habitats Directive as a species requiring special attention and protection. The species grows in rich fens, a groundwater dependent habitat type containing many rare and endangered species of vascular plants and bryophytes. Rich fens are characterized by low nutrient availability, stable water table and relatively high pH. In Denmark *Liparis loeselii* has recent populations in approximately 20 sites and the regional conservation status is considered unfavourable. Three main parameters are expected to influence the presence of *Liparis loeselii*: Nutrient availability, hydrology and disturbance. Here, we study sites with recent *Liparis loeselii* populations in relation to the three main parameters. We include data on vegetation and chemistry from the Danish national monitoring programme and supplementary data on nutrient status at micro habitat level. Nutrient status is assessed based on Ellenberg indicator values derived from species lists and chemical analyses such as N/P-ratio in plant tissue and C/N-ratio in soil. A detailed elevation model is calibrated with water table loggers in permanent wells as a measure of water table in the areas. The degree of disturbance is evaluated based on vegetation height, cover of trees and shrubs, trampling and bare soil. We model the habitat of *Liparis loeselii* evaluating these parameters at different scale and in plots with and without occurrence of the species. This model gives a more detailed understanding of the habitat requirements of *Liparis*

loeselii and is useful in optimizing the management of sites with current populations but also to discover areas which may potentially be suitable *Liparis loeselii* habitats.

O3 - RESTORATION OF SPECIES-RICH NARDUS GRASSLANDS: EXPLORING THE TECHNIQUE OF PHOSPHORUS MINING

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Species-rich semi-natural *Nardus* grassland is a high priority European habitat type (6230) that decreased dramatically in area due to agricultural intensification. Restoration is often difficult because of the high soil nutrient content, resulting from the heavy fertilization in an agricultural context. Since phosphorus (P) is one of the least mobile mineral nutrients, many agricultural soils have large reserves. High bioavailable P-concentrations homogenize the vegetation due to the dominant growth of a few competitive species. Standard restoration techniques consist of mowing and removal of cuttings in order to deplete the soil P-pool. As a consequence of nitrogen and potassium limitation, after few years the biomass production and consequently the removal of nutrients decrease. Therefore, mowing appears to be a time-consuming (several decades) management technique. A second method by which nutrients are rapidly removed is excavation of the P enriched topsoil. This is a very expensive operation where also the soil buffering components and soil biota are exported which might be crucial for successful reestablishment of species-rich grasslands. In this oral presentation, we elaborate on a third technique for removal of nutrients from the soil: the technique of P mining. This is a promising technique by which soils are depleted of P by cultivating crops with a non-P fertilization to maintain high biomass production, providing a gradual transition from agricultural to nature management on former agricultural soils. However, little knowledge is available on how much P can be removed and which crops should be used during the transition from phosphorus rich to phosphorus poor soil conditions.

We present data of both greenhouse and field experiments in which crops were cultivated in sandy soils with different bioavailable soil P levels ranging from 155 to 6 mg Olsen P kg⁻¹ dry soil (soil-P-chronosequence). Reference sites of *Nardus* grasslands are reported to have very low soil P-concentrations (< 10 mg Olsen P kg⁻¹ dry soil). Across the total soil-P-chronosequence, P-extraction decreased with soil-P-concentration, indicating retardation of the P-extraction process. Different crops were found to have specific P-extraction patterns depending on the soil-P-level. For each soil-P-level, the best suited crops and potential crop rotations resulting in maximum P-extraction will be presented.

O4 - SUCCESSIONAL PATHWAYS UNDER DIFFERENT NUTRIENT REGIMES: LESSONS FROM A PIONEER GRASSLAND

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Nutrient increase is a major threat for many types of endangered open vegetation. As a model system we used threatened base-rich sandy grassland (Fauna-Flora-Habitat area) in the northern Upper Rhine valley (Central Germany, near Frankfurt/Main), where a nutrient addition experiment in a five-fold replicated randomised block design was started in the year 2000. We analysed the whole data set for a twelve-year period. The following nutrients were added: nitrogen in low dose (n) to simulate an enhanced atmospheric deposition, nitrogen in high dose (N), nitrogen in high dose in combination with different micro- or macronutrients (NP, NPK, NPKM), phosphorus (P), and a carbon source (C) to immobilise plant-available nitrogen to our experimental plots. Vegetation was recorded twice a year (spring and autumn). The data set was analysed by means of detrended correspondence analysis (DCA) and linear mixed models.

The DCA revealed two successional pathways: a line, which is typical for infertile sandy grassland (treatment group 'N-': control, C, P, n), and another one, which was accelerated and clearly separated from the typical one

(treatment group 'N+': N, NP, NPK, NPKM). These separations were only detectable after a lag phase of about five years. As a general trend phytodiversity was reduced on all plots, but the decrease was significantly stronger on plots of the N+ group. The number of Red List species (including some site-specific species from pioneer stages) decreased with nutrient addition. Additionally, we observed an increase in cover of competitive grasses on plots with high dose N. In contrast, low-dose nitrogen and phosphorus only had no impact except for legumes, which were slightly facilitated. Clear separations of both treatment groups began already in the third year of nutrient addition.

It could be shown that the floristic structure, successional lines and phytodiversity of the studied system were changed after a five-year period and a threatened vegetation type was gradually replaced by one with dominant and/or competitive species. These findings emphasize the importance of long-term observations for the study of effects caused by nutrient addition.

P1 - NUTRIENT ADDITIONS IN PIONEER STAGES OF SANDY GRASSLAND: IMPACT ON PHYTO MASS PRODUCTION AND NUTRIENT CONTENTS

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Nutrient-poor, base-rich sandy grasslands in Central Germany are threatened plant communities of high nature conservation value. To study the threats of enhanced nutrient availability, caused e.g. by airborne nitrogen deposition or fertilisation, a field experiment with continuous nutrient additions was started in 2000 in a low-productive sandy grassland in the northern Upper Rhine Valley, Germany, near Frankfurt/Main (Fauna-Flora-Habitat area 'Ehemaliger August-Euler-Flugplatz von Darmstadt').

In a five-fold replicated randomised block design eight treatment types were installed. The treatments included the application (ten times per year) of organic carbon (C), phosphorus (P), nitrogen in low (n) and high (N) dose and combinations of high-dose N and P (NP), potassium (NPK) and other essential nutrients (NPKM). To analyse the effects on phytomass production of different plant functional types (PFTs) and nutrient content of plant tissues, phytomass was sampled once a year (in September), separated into PFTs and analysed for N and P contents. Data analysis was conducted by means of linear mixed models.

The phytomass results revealed a separation of the treatments into two groups: one without/low nitrogen dosages (N-: control, C, P, n) and another with high nitrogen dosages (N+: N, NP, NPK, NPKM). The above-ground phytomass production of phanerogams increased with nitrogen additions, whereas the phytomass production of cryptogams was lower on the N+ treatments. The separation of treatment groups began in the second and third year of nutrient additions, respectively. The N-content of above-ground phytomass of phanerogams did not show a consistent separation of the treatments, but the P-content was enhanced by P addition already in the first year of fertilisation. Nutrient contents of cryptogam phytomass revealed a similar trend, the separation of treatments according to the N-content was even more pronounced.

High-dose N-deposition is the main driver of productivity changes in our study system. As a response to nitrogen additions the phytomass production of different PFTs in these sandy grasslands was altered. P mostly seems to be stored in the plant tissue, whereas N is probably used for enhanced productivity.

P2 - VEGETATION IN WET DUNE SLACKS ON AMRUM – SUCCESSION AND MANAGEMENT

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Wet dune slacks belong to some of the most threatened ecosystems whereas important characteristics are: nutrient poor soils and high soil moisture. The succession series of these habitats develop from open pioneer vegetation to *Betula*-forests. Caused by regular disturbances, the hygroserie contains a high diversity in pioneer habitats with red list species like *Hammarbya paludosa*. Wet dune slacks are mostly threatened by scrub

encroachment, nutrient accumulation as well as soil acidification and drying out. Changes in vegetation between the years 1999 and 2012 were studied in the wet dune slacks of Wittdün on the North Frisian island Amrum. Changes in soil parameters such as pH, N, P and moisture were analyzed. Differences in successional stages between dune slack vegetation with and without management (tree removal) were considered. Furthermore, Ellenberg indicator values were used to determine differences during the period 1999 - 2012.

In the wet dune slacks of Amrum the vegetation mainly represents old succession levels including grass and scrub encroachment. Plant species composition shows a clear succession towards dense grassland, high scrub and first woodland. Particularly *Carex arenaria* and *Betula* spec. spread. Scrub and grass encroachment includes enrichment and accumulation of nutrients like N and P, as well as light limitation at the ground level, increase of acidification and decreasing soil moisture.

Only few wet dune slacks in Wittdün showed open and small vegetation, which indicates conditions of young hygroserie. A lot of pioneer species declined in numbers between the years 1999 and 2012. Different reasons can be found for progressing succession: climate change, ground-water withdrawal, limited irritations and limitation of land using.

By assessing the past management, the removal of trees, no significant differences in the vegetation of managed and not managed dune slacks were observed. Nevertheless, different management activities could have positive effects: removing of scrubs and trees, sod cutting, grazing and mowing. By removing high plants and sod cutting there would be a reduction of biomass and nutrients, increasing light intensity and lowering and remoistening the dune slacks

P3 - Life strategy of *Cerastium arcticum* Lange coll. in the gradient of bird colony impact

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Survival of plants in the harsh conditions of Arctic tundra is closely related to the presence of a bird colony as the main source of nutrients. Due to the unique habitat characteristics, the preferred survival strategy of the plants is vegetative cloning, and investments into reproductive biomass are usually limited to the years with more suitable climatic conditions. The aim of the presented research is to evaluate changes in the distribution of vegetative and reproductive biomass of a member of the Caryophyllaceae family – Arctic Mouse-ear (*Cerastium arcticum*) – along the gradient marked by the reach of the Little Auk (*Alle alle*) colony, and evaluation of the environmental influence on biomass allocation for the described species. The study took place in 2008 in the Arikammen ridge (Spitsbergen), whose peaks host a large Little Auk colony. Along the slope a 450 metre-long bird transect was marked, and samples for laboratory testing were collected from this area at set distances from the peak of the ridge. The other slope was treated in the same way but, as it was not a nesting area, it served as a control transect. For both transects soil chemistry was tested in the sampling places. In the bird transect, mouse-ear was growing up to ca. 130 metres from the colony, and in the control transect the plant was found up to ca. 50 metres from the top of the ridge. A characteristic trend was that within approx. 30 metres from the bird colony the proportion of reproductive biomass was significantly larger in comparison to the outer area of the bird transect, while the percentage of vegetative biomass in plants was reversely proportional – a significantly larger mass of roots and leaves was noted in the plant samples collected in the area located between 30 and 125 metres away from the colony. The habitat condition significantly influencing such allocation of biomass was the content of guano in the sample. No specific trends were observed in the control transect. The amount of both reproductive and vegetative biomass was much lower there than in the bird transect and did not change markedly with distance from the top, though Monte Carlo permutation test revealed a significant relation of ammonium ions to the state of plant mass in the samples from the control transect.

Session A1 - Ecology and conservation of open landscape habitats in Madagascar

Chairs: **P.O. Waeber¹, J. Mantilla-Contreras² & J.U. Ganzhorn³**

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Madagascar is globally renowned for its high forest endemism including the fauna (e.g., lemurs 100%) and the flora (vascular plants over 90%). However, over 80% of Madagascar landmass is covered by non-forested, open landscapes. This session will focus on all types of open habitats in Madagascar, e.g. coastal ecosystems, wetlands, grasslands and other open habitats, including natural and anthropogenically modified areas.

We welcome contributions that address biodiversity patterns, ecosystem functions and services, as well as ecological consequences of global change (e.g., climate change, invasive species or land use changes). We also welcome discussions on address management and conservation approaches touching on alternative resource use options, livelihood strategies and environmental education.

O1 - Sticking out the head of Madagascar's forest

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Madagascar is renowned for its incredible and unique biodiversity. When speaking of endemism and newly discovered species, in most cases reference is made to forested systems because they host over 90% of the mammalian biodiversity and over 80% of bird and amphibian species. These biodiversity rich forests are under extreme anthropogenic pressures; numbers range between 30-80% of the original forest cover that may have disappeared since the arrival of humans on Madagascar some 2,000 to 4,000 years ago. In terms of conservation and research efforts, forests have received most attention, mainly due to an international interest in Madagascar's rich and peculiar biodiversity.

Open landscapes characterize a majority of Madagascar's surface including coastal ecosystems (with more than 5,000 km shorelines). Inland, they are mostly dominated by open grasslands, with intermitted wetland systems in the central highlands and open dry grass and shrub dominated stretches in the south of Madagascar. The grand majority of the highlands landscape is thought to have been intensively modified and changed through continuous forces of farming (cattle grazing), agriculture, invasive species and predominantly anthropogenic fire regimes. Today, the open landscapes constitute a cultural and anthropogenic dominated space that is home to a significant part of Madagascar's 20 million inhabitants.

Land and landtypes that allow for agricultural food production are gaining increasing attention, locally as well as internationally. Open landscapes such as wetlands for example, provide crucial ecosystem services such as fish and reed material, assure hydrologic balance of entire regions allowing for rice cultivations or other agricultural productions. Such reservoirs of services are important in times where climatic changes are responsible for increasingly extended droughts (e.g., in the southwest) or extreme events such as cyclones (e.g., affecting more the eastern portion of Madagascar). Grasslands serve also as pasture for zebu, which are culturally and economically important, mainly in western and southern regions of Madagascar. As much as the zebu stages a symbol of wealth, land plays even a greater role in Madagascar. With a growing population, land is becoming scarcer. This gets accentuated when international attention arrives on the island. Landgrabbing, a global phenomenon, is also happening in Madagascar, and has led even to a political turmoil in 2009.

Open landscapes can constitute a key tool to "conserve Madagascar's remaining forests from the outside of forests". Focusing development and research efforts more towards open landscapes, where actual drivers of agricultural production, economic centres, and political decision making are situated, we assume that benefits for forests will indirectly increase. A better understanding of the anthropogenic use of open landscapes by the majority of the rural population should reveal best practices to preserve the adjacent forests, its biodiversity, ecosystem functions and services.

O2 - TURNING MADAGASCAR UPSIDE-DOWN: CHALLENGES AND OPPORTUNITIES OF MINING

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Mining is perceived as a threat to the persistence of Madagascar's original (forest) ecosystems. This seems virulent as large parts of Madagascar are covered by concessions for mining and oil & gas exploration and exploitation. Given the growing demands from industrialized nations, it is unlikely that mining can be stopped. But mining could be used as a tool for combining economic development with nature conservation outside the protected area system and to support improved management of protected areas (e.g., timber plantations, forest restoration, support of protect area management). According to the existing law, "Social and Environmental Impact Assessments (SEIA)" have to be completed and approved before mining can commence. International initiatives of IUCN together with the mining sector are developing voluntary guidelines for "best practices" and "no biodiversity loss" with the goal to achieve a "net positive impact" of mining activities in social, economic and conservation aspects. This "net positive impact" policy is difficult to enforce in small scale mining operations, but even the small mining operations could be requested to finance conservation offsets for their activities. This would require standardized SEIA of sufficient quality to quantify environmental losses, and a standardized legal framework for offset payments and the management of the funds. It would be the duty of the national government to implement the standard and the subsequent activities. Assuming that the country provides the social and contractual security required for any large operation, and while the country is developing the guidelines, the international conservation and mining community could spearhead such an approach, including an international and national control system. Since mining is just about to start in Madagascar, the country could set an example for good practice worldwide.

O3 - STUDY OF MOVEMENTS AND TERRITORY OCCUPATION OF TENRECIDAE IN THE DRY FOREST OF ANKARAFANTSIKA NATIONAL PARK

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Madagascar is well known by its small mammal fauna richness and endemism. The family of Tenrecidae is among the highest variety with 31 species. They are all endemic and distributed in many forest areas of Madagascar. Three species present in Ampijoroa forest (PNA): *Microgale brevicaudata* (Grandidier, 1899), *Setifer setosus* (Schreber, 1777), *Tenrec ecaudatus* (Schreber, 1777). Their habitats are disturbed mostly by human activities. Studies of their movements and territory occupation have been carried out in the forest of Ampijoroa in order to know the impact of the habitat deterioration (disturbance) to these Tenrec's species in the aim to adopt appropriate conservation strategy (activity) towards the protection of natural habitat. Surveys of these 3 species have been carried out during their activity periods (October to April) by using capture-mark-recapture and radiotelemetry. A measurement of few microhabitat variables characteristics have been performed to understand their microhabitat preference. We captured 43 individuals of Tenrecidae in Ankarafantsika National Park: 20 *Tenrec ecaudatus*, 20 *Microgale brevicaudata*, 3 *Setifer setosus*. The moving surface of *Setifer setosus* is 2599 m² and 12300 m² for *Tenrec ecaudatus*; we didn't get the moving area for *Microgale brevicaudata* because its small size makes them difficult to follow. They have not microhabitat preference; it means that they are present everywhere in the park. So, the conservation strategy consists to prevent the illegal entry in the park. The continuity of these studies is recommended in order to manage and to preserve the Tenrecidae species living outside the park.

O4 - PLANT PHENOLOGY OF MADAGASCAR DRY SPINY FOREST IN RELATION TO RECENT CLIMATE CHANGE

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In tropical forests, plant phenology shows complex links to environmental conditions such as air temperature (maximum and minimum temperature), precipitation, day length, and insolation. While seasonal variation in day length will remain unaffected, rainfall characteristics are expected to shift as the climate changes. In the context of climate change, most plants species of south-western Madagascar's dry spiny forest that respond to day length as a proxy for past rainfall patterns might face problems in reproduction if the shift of the peak precipitation becomes permanent. Certainly, this aspect will have far-reaching consequences for the functioning of natural ecosystems in south-western Madagascar.

The goal of this study was to document in the long term the phenological characteristics (general leaf, flower, and fruit phenology of different plant species) of different vegetation types in the spiny forest of southwestern Madagascar. In particular, we wanted to investigate whether plants use the actual rainfall or long-term conditions and day length as a proxy for long-term and evolutionary active forces that initiates specific phenophases in this seemingly unpredictable environment.

Since June 2007 to May 2013, phenological studies were carried out in Tsimanampesotse National Park, a spiny forest ecosystem in southwestern Madagascar. Six phenological plots of 5 x 200 m were installed and monitored biweekly in three vegetation types (dry forest on sandy soil, xerophytic bush on calcareous soil, and dry forest on ferruginous soil). The different phenophases could be linked to ambient conditions. Within a given vegetation formation, the deciduous plant species did not react in the same way to environmental factors. The loss of leaves was asynchronous among the different species in the same family. The majority of plant species lost their leaves during the dry season (April to November). In all plots, flowering showed a bimodal distribution: one group of species flowered during the dry season and the other group had their maximum flowering peak during the wet season (December to March). Fruiting started at the end of the dry and beginning of the wet season (December, January). The presence of leaves was linked to actual rainfall. However, day length rather than the actual rainfall triggered flowering and fruiting.

O5 - EFFECTS OF ECOSYSTEM DEGRADATION ON PLANT AND ANIMAL BIODIVERSITY IN THE MAHAFALY PLATEAU, SW-MADAGASCAR

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The Mahafaly plateau in south-western Madagascar is part of a semi-arid region, characterized by a high level of local endemism in plants and animals. The natural vegetation of the area would be deciduous spiny forests. However, poverty and the fast population growth lead to an increased exploitation of the natural resources in this remote area by the local population. Consequently, relatively undisturbed forests are almost completely restricted to the area of the local National Park Tsimanampetsotsa while the principle part of the Mahafaly plateau is dominated by relatively young half-open and open landscapes of anthropogenic origin.

The present extensive but non-sustainable land use practices for subsistence caused habitat degradation of forests (e.g. due to overgrazing, collection of firewood, logging and charcoal production) or even lead to their conversion to grassland (e.g. pastures) and cultural land (e.g. non-fertilized crop fields, hedges). Apparently, the land use type, land use intensity and the related landscape change of this formerly forested area have pronounced impacts on biodiversity patterns of the natural assemblages. The exact patterns of the biodiversity are, however, unknown.

Analyzing composition of assemblages of plants and ants from 135 plots from 15 villages in the Mahafaly plateau, we show that the effects of habitat degradation on natural communities differed among taxa. In plant communities, increasing habitat degradation lead to (1) decreasing local species richness, (2) increasing number of herbaceous neophytes and (3) decreasing species richness in woody species. Patterns of plant species

occurrence were nested, thus the extinctions related to habitat degradation were predictable. In contrast, species richness in ant assemblages did not respond to habitat degradation. However we found considerable species turn-over along the degradation gradient, and a considerable part of the ant species did not occur in open habitats. In both plants and ants, we found a homogenization of the assemblages with increasing degradation.

We conclude that, although the ecologic mechanisms differ among groups, substantial parts of the natural communities are highly sensitive to habitat degradation. Even though the land use practices in the area are very extensive, the half-open and open landscapes that replace the original forests are not capable for the preservation of a considerable part of the indigenous biodiversity. Thus, our findings emphasize the need for effectively protected forests and the establishment of sustainable land use practices on the Mahafaly plateau.

O6 - TO RESTORE NATURAL CAPITAL AROUND A LOWLAND RAINFOREST FRAGMENT IN ANALALAVA (FOULPOINTE), MADAGASCAR: MEETING THE NEEDS AND CONCERNS OF LOCAL PEOPLE

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The protected area of Analalava is located seven km from Mahavelona-Foulpointe, a town of 8000 inhabitants on Madagascar's East Coast. This 200 ha secondary forest fragment has high conservation value because of its numerous endemic and endangered species, and also because there is no other lowland humid forest left in the landscape. It has suffered from damages due to logging, wild fires, and slash-and-burn agriculture during the past and has seen its area reduced by 47 ha between 1979 and 2005. Since 2004, the conservation site is under management of the Missouri Botanical Garden (MBG), who currently distributes to local community seedlings of exotic, fast-growing tree species - *Eucalyptus robusta*, *Acacia mangium*, and *Pinus carai-bea* along with promoting the development of economic alternatives like ecotourism and fish-farming.

Natural capital has been defined by the Millennium Ecosystem Assessment project, (MEA 2005) as the stock of physical and biological natural resources (renewable, non renewable, replenishable and cultivated), necessary to human wellbeing and development. Here, we analyze perspectives to conserve and restore natural capital in the agricultural landscapes surrounding the Analalava protected area (0 – 10 km radius). Obviously this will require cooperation from local people. The objective of this study was to identify ecosystem services shared, or potentially shared, both by local people and conservation NGOs. This exercise should facilitate the management of this area where the objectives of "protecting biodiversity, securing rural livelihoods, and producing food" are all met, in the manner developed by the Landscape Measures Resource Centre (LMRC) (<http://landscapemeasures.info/>). For this, we worked with about a hundred people in six villages close to the forest, conducting both individual interviews and group surveys.

First, we aimed to quantify the perceived benefits that people enjoy from different landscape units in order to identify their level of interest in the forest and the different resources therein. Timber appeared to be the main form of ecosystem goods and services (EGS) recognized as valuable by local people, and they have suffered from decreased access to it as a consequence of the establishment of the protected area. Timber thus represents a critical nexus between conservation value and delivery of EGS to local people. Therefore, we identified indigenous plant species that local people use and protect, both for timber and other benefits, and that they would be likely to reintroduce in their fields, such as the multipurpose leguminous tree *Instia bijuga*. Secondly, we asked people to classify different tree species they would choose for timber use, according to the criteria of their choice, for example "hard wood" and "fast growing". After weighting the various criteria, some native species emerged at the top of the list in the favorite trees used for timber, ahead of the exotic species in the area. We conclude that free distribution of fast-growing introduced tree species should not be the only timber exploitation alternative offered, as it does not totally satisfy the needs of people. Therefore, a larger choice of tree species, including indigenous ones, should be proposed to the local population. This would also allow them to take an active part in the preservation and restoration of natural capital at the landscape scale.

07 - DECISION-MAKING PROCESSES IN NATURAL RESOURCE MANAGEMENT AMONG THE TANALANA (SOUTH-WESTERN MADAGASCAR)

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The Tanalana are an agro-pastoral society being economically and culturally centred on the zebu cattle. Long dry seasons and temporary migration of herds during the transhumance from the plateau to the littoral increase the pressure on the key resource *Euphorbia stenoclada* being used as forage plant. The local population discusses different approaches for sustainable utilisation and conflict prevention regulation by including different actors of the administrative and traditional level. The analysis of different social conflict situations inside the community and in interaction with external actors allows an understanding of communication structures and an identification of possible solutions for various resource conflicts.

08 - THE ALAOTRA MARSHLAND BIODIVERSITY PROJECT (AMBIO) AT LAKE ALAOTRA, MADAGASCAR – CONSERVING BIODIVERSITY AND ENHANCING LOCAL LIVELIHOODS FOR FUTURE GENERATIONS

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Lake Alaotra with its surrounding marshes represents Madagascar's largest wetland ecosystem of national importance for rice and fish production which is under severe threats due to a complex combination of economic, ecologic and social factors. The Alaotra region has experienced an uncontrolled, economically driven migration influx pushing its population from about 100,000 some twenty years ago to over 700,000 in the 2000s.

Even though the region has not the degree of endemic species as encountered elsewhere in Madagascar, it houses amongst others the endemic Alaotran Gentle Lemur (*Hapalemur alaotrensis*), Durrell's Mungo (*Salanoia durrelli*) and several endangered bird species. The wetland ecosystem is exposed to a variety of interlinked, interacting and reinforcing drivers and agents of change. Deforestation of the surrounding hill sides leads to intensive siltation in the lake during the wet season. The growing demand for agricultural land leads to the conversion of the marshes dominated by *Phragmites communis* and *Cyperus* spp. into rice fields. Fire, a major agent of change is used for land conversion or harvesting of the invasive fish species *Channa maculata* during lower water levels in the dry season, and marsh vegetation is cut down mainly for construction material (housing, fences). Lake Alaotra suffers from eutrophication due to influx of fertilizers and pesticides from the surrounding agricultural matrix. Overfishing is the result of an increased regional and national demand for fish. The invasive plant *Eichhornia crassipes* is blocking channels, intensifying evapotranspiration and hindering regeneration of reed beds and burnt patches of marshland. Extended droughts are further threatening the hydrologic balance of the wetland ecosystem.

The AMBio Project started in autumn 2012 as a joint effort by the Ecology and Environmental Education Group at Hildesheim University, Germany and the NGO Madagascar Wildlife Conservation (MWC) present at the lake since 2003. Taking a holistic and transdisciplinary approach, AMBio tries to tackle the wicked problems using different scientific, educative and participative methods in the field presented in this talk. Its overall aim is to establish a culturally adapted scheme of sustainable resource use guaranteeing also the conservation of ecologically intact marshlands and the longtime survival of local biodiversity.

O9 - *EICHHORNIA CRASSIPES*, CURSE OR OPPORTUNITY FOR LOCAL STAKEHOLDERS AT LAKE ALAOTRA?

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Massive hill slope erosion represented by widespread gullies called 'lavaka' (Malagasy word for 'hole') characterizes an extended area of Madagascar's open landscapes in the central highlands. A similar picture is found in the Alaotra region, where the biggest fresh-water wetland complex of the country is located. The Alaotra wetlands are important for rice and fish production and support many endemic species. The over-use of chemical fertilizers and pesticides might have fostered invasive plant species, especially *Eichhornia crassipes* (water hyacinth) which is now present around the lake. The plant causes several ecological and economic problems, but it might also constitute an opportunity as an alternative resource use option.

Within the interdisciplinary project AMBio Madagascar, we assessed drivers and barriers for the utilization of *E. crassipes* (composting and handicraft) as an alternative income. Three sites have been chosen according to anthropogenic use and marshland degradation: (I) Anororo (western part, high degradation), (II) Andreba (eastern part, medium degradation) and (III) Vohimarina (northern part, low degradation). Structured interviews and surveys with rice cultivators, vegetable farmers, fishermen and cattle breeders were performed. The stakeholders in Anororo are mostly aware that *E. crassipes* is an invasive species and it causes problems in fishing activities and Lake accessibility, but they have a lack of knowledge in terms of using this plant. In contrast, stakeholders in Andreba show the least awareness of *E. crassipes*, but seem to have more knowledge about how to use it alternatively to substitute other natural resources. Stakeholders in Vohimarina where *E. crassipes* is less abundant, would prefer to transport *E. crassipes* inland to let it dry if the plant would become too abundant in the near future.

Comparative experiments were carried out to study the technical, economic and production efficiency of using *E. crassipes* as compost compared to local cow dung and industrial fertilizer (urea). It took two months to have the composts ready. Nine growth experiments with salad were performed. The general growth (length and diameter) and leaf qualitative and quantitative parameters (colors, thickness, length and width) of the salads were measured. First results showed that plant vigor increases with *E. crassipes* composts and cow dung and low growth was noticed with green manure and urea. *E. crassipes* compost could replace cow dung, which is rare and expensive.

Handicraft with *E. crassipes* has been tested with the expertise of local artisans. The economic analysis of all the costs (time, material, human resources) and consent prices have been recorded. Consent prices for *E. crassipes* are similar compared to those of the ubiquitous handicrafts made out of *Cyperus* spp. representing a potential barrier to the utilization of the former.

Given *E. crassipes*' abundance and prevalence it has the potential to improve local livelihoods and alleviate the pressure on the wetlands by focusing on simple and locally already available tools thus ensuring financial independence from external funding.

O10 - ARE THE FUTURE RESOURCE USERS AWARE OF THEIR ENVIRONMENT? ENVIRONMENTAL EDUCATION IN ITS INFANCY AT LAKE ALAOTRA, MADAGASCAR

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Emanated from simple nature study, developed towards conservation education and environmentalism, Environmental Education (EE) today comprises knowledge, understanding of environmental processes and skill development to enable informed decisions and actions. A definition of EE first appeared in 1969 and in the following years, United Nations Education Scientific and Cultural Organization (UNESCO) and United Nations

Environment Program (UNEP) agreed on the Stockholm Declaration (1972), Belgrade Charter (1975) and Tbilisi Declaration (1977) to preserve and enhance the environment. EE was declared to be a suitable and necessary approach to address global environmental problems to assist in and support sustainable development of communities.

Despite decades of conservation and development interventions, Madagascar is still one of the poorest countries. The Lake Alaotra wetland complex provides important fish and rice output to local stakeholders. These comprise rice cultivators, fishermen, vegetable farmers and cattle breeders. To better balance conservation of the already severely degraded environment with development needs the project AMBio (Alaotra Marshland Biodiversity) takes a holistic approach to the Alaotra wetland system thereby addressing all three dimensions of sustainable development (ecology, society, economy).

With primary schools being the main institutions for formal education in Madagascar's rural areas, the goal of this study is to assess the status quo of EE in the Alaotra primary public schools. With nearly 50% of its population below the age of 15 years, targeting primary schools for EE efforts assumes to reach significant numbers of future resource users, thus contributing to improved awareness of and appreciation for their natural environments. We surveyed 18 primary public schools around the lake and identified barriers to the implementation of EE. The qualitative methods entailed semi-structured interviews, Focus Groups, Advisory Group, participant observations and archival research, allowing for triangulation of findings.

The current school curriculum has no specific course on EE, and is mainly designed for knowledge transfer only. The CISCO (school board) has recently started to encourage teachers to replace pure ex-cathedra teaching with a more interactive form of teaching to promote understanding of learning matter. However, barriers to its implementation are structural limitations such as lack of resources and tools, low wages and levels of teacher education, as well as reduced motivations and under-performance of teachers. In order to promote and permanently embed EE into school curriculum, these barriers need to be overcome. Previous research showed that children from schools with EE significantly gained environmental knowledge and showed increased understanding for conservation issues. Hence, identifying new and locally sustainable methods to include EE into the primary school's curriculum will improve knowledge and understanding of the natural environment in the long run, thus promoting and facilitating actions towards conservation of the Alaotra marshlands.

O11 - INFLUENCE OF FIRE AND GRAZING ON THE FLORISTIC RICHNESS AND DIVERSITY OF THE SAVANNAS OF EAST OF MADAGASCAR (CASE-MAHABO MANANIVO)

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Savannas which occupy 75% of the area of the region is the main focus of this study. Savannas are covered annually by the fire to renew grazing. The feed consists essentially of grassland species. Therefore, fire and grazing are recognized as the two factors influence the dynamics of savanna vegetation. All these considerations led us to develop a multi-year experimental device to detect the recurring effect of fire and grazing on species richness and floristic diversity of savannas. This study on three years elapsed from 2010 to 2012 to test the following hypothesis: fire and grazing reduce the richness and floristic diversity. The experimental device consists of a factorial experiment arranged in a randomized complete block design with split-plot. It was installed in March 2010. The factors studied are fire with three modes (control, early fire late fire) and the pasture with two modalities (grazed and ungrazed).

The results over the three years of experience have shown that fire reduces species richness in generic and specific level and grazing increased species richness. Fire reduces index Shannon & Weaver especially after the passage of fire and grazing late determines an increase in this index.

P1 - LEMUR HABITAT RESTORATION TO FACILITATE DISPERSAL BETWEEN FOREST FRAGMENTS

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Lemur habitats in Madagascar are highly fragmented. Even in the absence of additional threats, such as hunting or climate change, the single fragments are unlikely to maintain viable populations for extended periods of time. Restoring corridors between fragments and thus connecting isolated subpopulations is one option to facilitate population management and the survival of lemurs. Since trees need time to grow, the question is, how a forest has to look like and at which state a restored forest becomes functionally operational and allows the dispersal of lemurs between forests across an unsuitable matrix.

Within the QMM environmental activities, we established a corridor between two isolated fragments of littoral forest in south-eastern Madagascar. The corridor consists mainly of native trees that were planted in 2009. Subsequently we set traps at both ends of the corridor to monitor possible exchange of individual *Microcebus murinus*. Within the four years of its plantation, no individual *Microcebus* was caught at both ends of the corridor. Thus, we could not document movements through the corridor of specific animals. However, in 2012, *Microcebus* were caught within the corridor, indicating that the corridor was operational for small arboreal lemurs.

P2 - THE ROLE OF NON-NATIVE PLANT SPECIES FOR NATURE CONSERVATION IN MADAGASCAR

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Madagascar, well-known for its high biodiversity and endemism, is one of the most important conservation areas in the world. High risks of extinctions are predicted for the endemic fauna, mainly due to habitat fragmentation and climate change. Building ecologically friendly habitats as buffer zones and corridors to connect isolated patches of native ecosystems is important to maintain viable populations of Madagascar's biota. Several aspects need to be considered: First, plant communities have to serve as habitat and food for animals. Second, fast realization of building these connecting habitats must be secured. Third, rural populations must not be disadvantaged by conservation measures. Certain introduced species are promising to combine these three features.

In an extensive literature search 100 (7.25%) of the 1379 non-native plant species in Madagascar (Kull et al. 2012) were found to be used by endemic animal species. As food, they serve mainly to primates, bats and birds, and as habitat to all non-vertebrate animal groups. Ninety-nine vertebrate species were found to use introduced plants, hereof six critically endangered and ten endangered species. Thus, with introduced plants contribute to the survival of threatened animal species by providing food and habitat for endemic animals. Fast growing species have the potential to be an important component within buffer zones that can be combined with economic benefits for the local people. Supported by SuLaMa and IRD.

P3 - IMPACT OF LAND USE TYPES ON THE RICHNESS AND COMPOSITION OF REPTILE COMMUNITIES IN SOUTH WESTERN MADAGASCAR

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Madagascar is one of world's largest islands. Today it is one of the five hottest biodiversity hotspots in the world. Deforestation of spiny forest between 1950 and 2000 was 28%. Despite water as a limiting factor reptiles also

occur in the southern spiny forests of Madagascar with a total of 145 species. We examined the impact of land use types on the richness and composition of reptile communities in these dry areas. Due to their high potential as indicators for habitat change and the condition of a habitat, reptiles seem to be adequate taxon to examine.

In order to study species responses to anthropogenic disturbances it is essential to install a measurable gradient of the anthropogenic disturbance itself. Therefore the study was conducted in and around the Tsimanampetsotsa National Park as well as around the village of Andremba, which lies around 50 km further east. To quantify species distribution and composition standardized inventories were conducted in three habitats for both regions: agricultural used fields, degraded forest and protected (for the Tsimanampetsotsa National Park)/ sacred forest (for Andremba). Field work was carried out from January to April, 2012.

Both regions showed no significant differences in reptile species richness between their forest habitats, though around Andremba more species occur in the degraded forest. In and around the Tsimanampetsotsa National Park the difference is smaller and the peak of species occurs in the protected forest. It seems as if the sacred forest near Andremba ensures a higher protection status than the national park and that slight degradation ensures a higher richness of reptile species. Around the national park species richness in the fields is higher than around Andremba. This might be due to the occurrence of *Opuntia* as a perennial plant in the field's matrices in Tsimanampetsotsa.

P4 - RESPONSE OF REPTILES TO SHORT-TERM CHANGES IN HABITAT CHARACTERISTICS IN TSIMANAMPETSOTSA NATIONAL PARK

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Reptiles are considered good indicators for habitat characteristics. Yet, animal indicators for changes in habitats are likely to react to these changes with lag times up to several years or generations. During a long-term monitoring program on the dynamics of reptiles in Tsimanampetsotsa National Park (southeastern Madagascar), our study area has become partially degraded within a few months due to cattle grazing and associated human activities. We compare the vegetation structure at the same month but in different years before and after the degradation and link the results of standardized monthly reptile inventories to the disturbance effects.

This study is part of a BMBF funded project on development of sustainable land use in Madagascar ("SuLaMa").

P5 - EFFECTS OF TRANSHUMANCE ON THE RICHNESS AND COMPOSITION OF BIRD COMMUNITIES IN TSIMANAMPETSOTSE NATIONAL PARK

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In Southwestern Madagascar, livestock (zebu) is a major source of income and insurance for the people. Due to the marked seasonality, livestock use different regions during the course of the year and cross the National Park of Tsimanampetsotsa twice per year. In order to assess possible effects of the transhumance, we collected data on bird species composition and abundance in three sites inside the park along the route of transhumance from January to May 2012. Bird species composition and species richness have been related to anthropogenic pressures. The results showed that the bird abundance suffer from the transhumance while species richness was not affected. Vegetation structure seemed more important for species distribution than transhumance effects. But ten bird species have been identified to be hunted during the transhumance as well as during their everyday life. This seems to represent the major pressure on the avifauna in relation to transhumance.

This study is part of a BMBF funded project on development of sustainable land use in Madagascar ("SuLaMa").

P6 - INFLUENCE OF TRANSHUMANCE ON SPATIO-TEMPORAL DYNAMIC OF FOREST COVER IN SOUTHWESTERN MADAGASCAR

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Anthropogenic pressures on natural resources lead to disequilibrium of terrestrial ecosystems and loss of biodiversity. Through the different modes of the environmental exploitation, disturbances exist on the natural processes of vegetation succession. Although, slash-and-burn agriculture is the major cause of degradation and deforestation in Madagascar, farming system especially transhumance could also cause these effects that, nowadays, still remain unknown. Deforestation is a major threat to the Malagasy forest. This study was carried out in the Mahafaly Plateau, southwestern Madagascar, one of the areas where the deterioration of the forest cover is alarming. It aims to characterize the influence of transhumance (periodic movement of livestock particularly zebu from a grazing area to another according on the season) on the spatio-temporal dynamics of forest cover. The remote sensing techniques have used to compare two Landsat images between two different dates (1989 and 2011) in the study site and landscape ecology techniques allowed to detect and quantify the changes that occurred between 1989 and 2011. Three dynamic processes have been identified: (i) reconstruction, (ii) substitution and (iii) deforestation. Deforestation is usually preceded by fragmentation. During 22 years, over 80% of the areas occupied by dry forests have been converted into secondary forest. In general, causes of the decline in forest cover are of anthropogenic origin. Thus, transhumance is often accompanied by non-controlled use of forest resources that could influence on forest cover dynamics in the region because the trail allows easy access to these resources and it takes more space in the forest.

P7 - BIRD COMMUNITIES IN DIFFERENT ANTHROPOGENIC HABITATS IN SOUTHWESTERN MADAGASCAR

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In the past, research in Madagascar has been focused on "pristine" ecosystems at the neglect of anthropogenic habitats. As a result, next to nothing is known on responses of plants and animals to anthropogenic disturbance and the potential of anthropogenic landscapes to act as buffer zones around protected areas or corridors that could facilitate the exchange of individuals between populations. Within a project on sustainable land use in south-western Madagascar, we analyzed the distribution of birds in various forms of land use in order to evaluate how different types of land use might affect species richness and composition. Species distributions and composition were quantified using standardized point counts within littoral forest, dry spiny bush, farmland, pasture, and vegetation structures associated with these forms of land use, such as hedges and fences.

Bird species declined with declining structural components from forest to farmland and pasture and in relation to human presence. The latter is due to the important role even small sized bird species play for bushmeat consumption. The most important bird species in farmland were seed-eating species that can become pests for agricultural production. Thus, while it seems possible to structure agricultural landscapes in a way that could serve as buffer zone or corridors, promoting habitat for birds is likely to generate conflicts of interest with local farmers.

This study is part of a BMBF funded project on development of sustainable land use in Madagascar ("SuLaMa").

Session B1 - Long-term sustainability of dynamic open habitats as biodiversity hotspots

Chairs: **M. Nadjafzadeh¹, H. Buschmann¹, K. Knorr² & C. Neubeck³**

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Dynamic open landscapes with structural diversity provide suitable habitat conditions for many endangered plant and animal species. However, highly developed areas like Central Europe are faced with the substantial loss and fragmentation of dynamic open habitats due to land-use change as a consequence of the abandonment of extensive agriculture and increasing anthropogenic infrastructure. The regulation of rivers and brooks also caused the loss of valuable open wetlands. Therefore, the aim of our session is to provide suitable approaches to preserve and restore open unpredictable environments that serve as biodiversity hot spots by facilitating the coexistence of various species. Since natural open habitats have become extremely rare in countries with highly altered landscapes like Germany, the maintenance of semi-natural open habitats is an alternative approach to provide endangered species the possibility for survival. Typical semi-natural habitats are military training grounds, stone quarries and clay-, sand- and gravel-pits.

This session invites studies on such dynamic habitats demonstrating their significance for successful biodiversity conservation in the present-day. The yellow-bellied toad (*Bombina variegata*) is an indicator species and representative for pioneers dependent on open and structure-rich landscape. Since this amphibian is critically endangered in Germany, measures to protect this species and its habitats are urgently needed. The session encourages projects realizing conservation measures for pioneer species like the yellow-bellied toad. It offers also a platform for conservation genetic studies revealing phylogeographic structures and genetic diversity of pioneers. We target to provide information about the restoration of natural habitats such as meadows and floodplains as well as the maintenance of semi-natural habitats such as former excavations. Our session features examples that show how restoring dynamic open habitats with temporary small water bodies result in areas rich in rare species. We warmly welcome concepts for keeping habitats open like the periodical use of heavy construction vehicles or the installation of grazing systems. Among the topics to be discussed here are long-term action plans and cooperations with relevant stakeholders such as representatives of the extractive industry as key for sustainable management of open and dynamic landscape habitats.

O1 - REINTRODUCING DISTURBANCE IN COASTAL DUNES

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Coastal dunes are dynamic systems maintained and renewed by disturbance. The major coastal dune habitat types are listed on the Habitats Directive (Annex I) as habitats of conservation interest. Historically, dune succession has been repeatedly renewed by disturbances e.g. in the form of grazing animals and periods with strong winds. Since the beginning of the 1900 grazing has been abandoned in European dunes and these have been stabilized. As a result dune habitats are threatened by weakening of the natural disturbance regimes caused by encroachment, nutrient enrichment and anthropogenic disturbance control.

We assessed the effects of different disturbances and N-deposition on plant and invertebrate species richness and composition in two coastal dune areas in NW Jutland, Denmark: We combined an observational study in dune heathland with a multifactorial experiment in dune grassland to assess the effects of simulated grazing, blowouts, trampling, burning and N-deposition on plant composition and productivity in dunes. Invertebrate species richness and distribution were also assessed in the observational study.

Based on reported negative effects of N-deposition on terrestrial biodiversity we expected increased biomass and decreased plant species richness with N-addition in the experiment. Contrary, disturbance was expected to counteract the effects of N-addition by increasing plant species richness and promoting less competitive and ruderal plant species. Invertebrate species were also expected to respond to disturbance, with increasing numbers of open habitat species and species preferring xeric conditions. At larger scale, different types of disturbances were expected to increase habitat heterogeneity with positive effects on beta-diversity.

We found the positive effects of experimental disturbances to exceed the negative effects of continued N-deposition on plant species richness, biomass and species composition. Moreover, disturbances worked differently on plants and invertebrates. Plant composition was significantly different across disturbance types whereas invertebrate species composition only differed between disturbed and control plots. Invertebrate communities were more diverse in disturbed plots and were characterized by specialist species adapted to early successional stages of grassland and heath on warm mineral soil with sparse vegetation cover. Disturbance increased beta-diversity in general but affected plants more than invertebrates, likely because of the difference in capacity for dispersal. Moreover, a mixture of disturbances seemed to maximize diversity.

Disturbances by wind, fire, coastal erosion or grazing animals is critical for maintaining species diversity in coastal dune grassland and suppressed disturbances may potentially be a larger threat than increased N-deposition. We suggest an introduction of disturbance focused management including large herbivores in coastal dunes to preserve species richness and composition preferably including several kinds of strong, large scale disturbances to enhance the mosaic of older and younger dunes.

O2 - FALSE HEATH FRITILLARY MEADOWS: MODELLING SUCCESSION AND SPATIO-TEMPORAL CONNECTIVITY OF THE HABITAT NETWORK

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Extensively managed agricultural landscapes and natural disturbances of ecosystems have declined in many parts of the World. In the Northern Taiga, where open landscapes exist mainly as early-successional stages of forest ecosystems, the loss of processes that maintain landscapes open may increase not only spatial but also temporal fragmentation of open habitat networks. This threatens the long-term viability of metapopulations living in early-successional habitats.

Regular management of open habitats for conservation purposes is often costly. Therefore, we need to develop better understanding on how limited management resources should be distributed in time and space to maximize the spatio-temporal connectivity of dynamic open habitats. The first step in the process is to collect evidence on the drivers behind habitat turnover so that the effects of management activities can be understood and modelled at the landscape level. This data can then be combined with species data to model the outcomes of various habitat management scenarios to the viability of the species being conserved.

I present an ongoing case study carried out on an endangered Finnish butterfly, the false heath fritillary. The species has gone through a drastic decline in Finland along with agricultural modernization, which has rendered its habitats, moist meadows, unprofitable to maintain for landowners. Conservation of this species is mainly carried out in short-term projects. I collected data on 92 false heath fritillary meadows, 37 of which were delineated as false heath fritillary habitats 20 years ago, and recorded their maintenance history, land use type, soil moisture, vegetation, host plant density and false heath fritillary occupancy. Next, I studied the relationships of these variables by using Generalized Linear Models. The results indicated a high 20-year habitat turnover rate and statistically significant linkages between studied variables, for instance from land use type to tree and willow overgrowth and to host plant density, from soil moisture to host plant density and from tree cover and host plant abundance to the probability of false heath fritillary sightings. Host plant density showed a stronger linkage to the long-term management history of the meadows than time since the last maintenance activity.

Field studies may reveal complex interactions of various factors affecting habitat turnover. My study case shows high variability in the habitat turnover rate depending on spatial location, possibly depending on the nutrient content and the humidity of the soil. The quality and accuracy of land use history data is a critical factor to a successful analysis. The increasing availability of GIS data sets may provide new opportunities for studying habitat turnover, as data on land use histories, soil types and delineations of past habitats of endangered species are more easily available for analysis.

O3 - How the biodiversity is affected by varied fire intensity? A case study in a Mediterranean island (Zante, Greece) using plant and bird taxa

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Repeated fires could affect the Mediterranean landscapes, reducing their mosaic character and consequently affecting the existing biodiversity. In this study we evaluated the post-fire impacts on biodiversity and ecological coherence of the open and Aleppo pine forest habitats in the Zante Island, Greece. Data were collected in summer of 2012 in 20 sites following the stratified random sampling method on the basis of fire intensity: 1) sites with pine forests that remained non-burnt for more than 40 years, 2) sites with forests that were burnt the last time during the period 1975-1985, 3) sites burnt twice between 2000 and 2010, 4) sites burnt three times between 2000 and 2010, and 5) sites last time burnt in 2011. In this context the post-fire effects on plant and bird diversity of the studied habitats were investigated. A total of 81 plant species and 29 bird species were recorded in the studied sites.

DCA ordination revealed a clear gradient of fire intensity from the intensively burnt open habitat sites to the non-burnt forest sites for more than 40 years. RDA analysis depicted a clear differentiation of the fire-tolerant plant and bird species in the open habitat sites (phrygana and open areas) from the relatives in a more forested habitat. One-way ANOVA analysis showed that fire intensity has a significant impact on the alpha floristic diversity (plant species richness). Average plant species richness of the recently burnt sites in 2011 was significantly higher than that of the burnt sites during the period 1975-1985. The detected differences in bird species richness were not significant although more species were found in the forested habitats.

With respect to flora and bird fauna, the highest similarity, calculated as Jaccard similarity index, was observed between the non-burnt sites for more than 40 years and the burnt sites during the period 1975-1985. The lowest floristic similarity was observed between the recently burnt sites in 2011 and the burnt sites during the period 1975-1985, while for the birds between the recently burnt sites in 2011 and the non-burnt sites for more than 40 years. According to the findings of the present study, the open habitats of Zante Island showed a noticeably high recovery from fire. Similarity results, in particular for plant species, depicted a pattern (already recorded in literature however for species richness) with the first maximum during the initial post-fire period and the second maximum during the transition phase to the Aleppo pine dominance. For the bird assemblages the differentiation among sites was not very noticeable, but the maintenance of the vegetation mosaics (different level of landscape openness) is crucial for the preservation of bird richness.

O4 - LIMESTONE QUARRY LANDFILL NEXT TO VALUABLE DRY GRASSLAND – WILL THEY SHARE BIODIVERSITY?

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Newly formed man-made habitats are today a common thing in our landscape and their evolution depends on many factors. One of them that strongly influences the course of vegetation succession is the availability of a plant species source. However, there are still questions as to how exactly species migration occurs and what are the spatio-temporal patterns of species migration from source. The answers are important especially because of their applicability in management and restoration of human-disturbed areas and because they can help understand how biodiversity is formed in time and space.

We studied the initial three years of spontaneous succession in an abandoned limestone quarry in the Czech Republic. Apart from describing the ongoing succession and the abiotic conditions on the landfill, one of our principal aims was to describe the small-scale patterns of plant species migration from valuable dry grassland which is situated next to the quarry. We specifically asked about the changes in species diversity and composition during the observed three years of succession and the extent in which species from adjacent grassland participate in the succession. Also, we examined if the participation of dry grassland species varies over time and with distance from the species source.

On the landfill itself, we used repeated vegetation sampling of 30 permanent plots (1×1 m), distributed into a 50×100 m rectangle net, where we observed changes in species diversity and composition over time and space. To estimate species sources, we also recorded surrounding vegetation and installed seed traps on the landfill.

Besides rising number of species and rising participation of dry grassland species over time, we discovered the relation between the distance from the species source, vegetation development and establishment of grassland species: grassland species can reach mostly sites within 20 meters from the source and they also spread faster on these close sites. Moreover, in the third year, we observed the effect of “expansion nuclei” – a small-scale spread of already established grassland species as a result of their reproduction or vegetative growth.

We conclude that in our case, the newly formed habitat on the landfill is starting to share the grassland's biodiversity. It is true that sites closer to the species source seem to have higher probability of colonization, however, the influence of distance to the species source might decrease with increasing age of the community, mainly due to the reproduction of already established plants. It is not then unreasonable to expect the community on the landfill to head spontaneously in the direction of the adjacent grassland.

O5 - PROJECT "YELLOW-BELLIED TOADS IN NORTHERN HESSE" - THE YELLOW-BELLIED TOAD (*BOMBINA VARIEGATA*) AS AN INDICATOR SPECIES FOR THE REVITALISATION OF SUBMONTANEOUS FLOODPLAINS IN NORTHERN HESSE

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The original habitats of *Bombina variegata* lay in dynamic floodplains of sub-mountainous areas. Here it spawned in temporary ponds, periodically developed by floods and heavy summer rain. Nowadays rivers are mostly paved, meadows drained and formerly rich structures are leveled out. In its Mid-European range, the yellow-bellied toad is mostly restrained to artificial habitats like gravel pits and military training areas. Its survival is strongly dependent on supporting measures. In northern Hesse, the species is critically endangered. Revitalisation of floodplains and management of these areas through extensive pasturing potentially enables a return of *Bombina variegata* to its former original habitat. In the project „Yellow-bellied toads in Northern Hesse“ (2011-2014) different measures and studies are conducted. This article focuses on measures and studies examined in the Middle Fulda-river region, 50 km south of Kassel. Here, few midget populations survived in the floodplain. The measures aim at population-consolidation through immediate action (digging spawn ponds) and installation of extensive pasture in rehydrated meadows, to assure sustainable habitat conditions for repopulation of the Fulda-floodplain. The capture-recapture analysis serves as assessment of success and the study of significant questions for successful biodiversity conservation, such as the potential repopulation of renaturalised floodplain-areas or the impact of extensive grazing. We also studied ecological free-rider effects for other species with similar habitat-requirements. In 2011, after dry spring weather, we counted 585 individuals (less re-captures, including 86% young), therefrom 53% in the floodplain. 9 out of 10 areas showed evidence for reproduction. 2012 was a wet summer. We counted 2.049 individuals. The populations indicate rejuvenation with many subadult individuals. 2012 evidence of reproduction was only provided in 7 out of 11 areas. Due to abundant rainfall many ponds did not dry-out until late summer. Consequences were a visible decrease of reproduction success through predation. We found best reproduction success in artificial habitats with new ponds without vegetation, exclusively managed for the yellow-bellied toad. The project objectives, to develop near-natural habitats in pastures or flood-channels, are much more challenging. Nevertheless, extensive cattle-pasturing in rehydrated floodplains had a positive impact: local consolidation through hoof-step led to formation of temporary muddy ponds, in which reproduction was evident. Semi-natural flood-ponds in revitalised floodplains showed the vital importance of flood-dynamics, comprising temporary dry-out and fluctuating water-level in spawning-ponds; if dewatering took too long, permanent ponds developed, or if flushed too often by small floods, they were not accepted for spawning. An aggravating factor was, that individuals were very difficult to find in structure-rich, near-natural habitats like wet meadows. In evidence were ecological free-rider effects, recorded for birds and dragonflies. White and black stork e.g. foraged frequently on the wet meadows. Common snipe responded with an increase during the migration period.

O6 - CONSOLIDATION AND INTEGRATION OF YELLOW-BELLIED TOAD POPULATIONS (*BOMBINA VARIEGATA*) IN GERMANY

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Biodiversity hotspots such as dynamic open landscapes are becoming rare in Central Europe. Particularly during the last decades, the anthropogenic land-use change is considerably increased and results in highly fragmented landscapes lacking extensive agriculture and valuable open wetlands. In consequence, many pioneer species adapted to unpredictable environments are losing their habitats and become threatened, such as the yellow-bellied toad (*Bombina variegata*). This indicator species suffers from several anthropogenic threats and is critically endangered in Germany. Therefore, a large-scale project was initiated in 2012 to restore dynamic open habitats and realize comprehensive conservation measures for pioneer species, with yellow-bellied toads as representatives. The purpose of the NABU Lower Saxony and nine project partners is to consolidate yellow-bellied toad populations, create stepping stones between habitats and reintroduce this amphibian species to connect isolated populations. Furthermore, we engage stakeholders and the broader public and establish sustainable action plans for the long-term maintenance of the project habitats. As part of the Federal Programme for Biodiversity, our joint project is conducted during a six-year period throughout Germany, in 5 federal states, 8 regions and 130 areas comprising primary habitats such as floodplains and secondary habitats such as former excavations. Project measures include the survey of yellow-bellied toad populations and their habitats, the creation of raw soils and temporary small water bodies and the installation of grazing systems. Our first monitoring of yellow-bellied toads revealed that this species currently occurs in 68 of the 130 selected project areas, predominantly in very small populations with unfavourable conservation status. As first step to consolidate these populations, we created more than 1,000 small water bodies serving as spawning ponds by the use of heavy construction vehicles in the last autumn and winter season. We prepared the reintroduction of yellow-bellied toads by providing suitable habitat conditions at selected release sites and conducting genetic and health screening of the source populations. Numerous cooperation agreements were made with relevant stakeholders such as representatives of the extractive industry to manage semi-natural open habitats like stone quarries and clay-pits. Project information to the wider public was provided by talks, reports, a web site and excursions to semi-natural habitats. We believe that the combination of large-scale conservation management for pioneer species and their habitats and the early involvement of all relevant stakeholders is a key for the sustainable maintenance of dynamic open landscapes.

O7 - GENETIC POPULATION STRUCTURE OF THE FIRE-BELLIED TOAD (*BOMBINA VARIEGATA*) IN TIME AND SPACE. IMPLICATIONS AND CONSERVATION

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Main reasons for the decline of amphibian populations are habitat loss and habitat fragmentation. This is also the case for the critically endangered yellow-bellied toad (*Bombina variegata*). Most of the existing populations near the northern limit of their distribution are fragmented and isolated. We used molecular methods (ten highly variable microsatellites) to reveal and understand the effects of this habitat fragmentation on the genetic structure and genetic diversity of yellow-bellied toad in their northernmost distribution in Germany.

Additional to this spatial genetic structure we assessed the possibility of "isolation by time". In species with a prolonged breeding season groups of individuals might reproduce at different time periods. Gene flow could be restricted between early and late reproducers even for a population in the same habitat when the reproductive time period is heritable. The reproductive period of the yellow-bellied toad starts in April and runs until August. The extended reproductive period implies that groups of yellow bellied toads might be behaviourally and genetically isolated from each other due to "isolation of time", as it was found in other amphibian species.

Here we report your first results of this study and discuss the importance of our findings for the conservation of *Bombina variegata*.

P1 - NATURA 2000 SITES IN NORTH-EASTERN POLAND AND THE PROTECTION OF BIODIVERSITY IN FORESTS

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The Natura 2000 network was established to effectively protect natural habitats and species important in European Community. Basis of its establishment in the particular countries are two legal acts: Council Directive 79/409 EEC of 2 April 1979 on the conservation of wild birds, known as the “Birds Directive” and Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, known as the “Habitats Directive”.

The Natura 2000 areas should be created as system of be valuable environmental areas connected by ecological corridors, the fragments of the managed landscapes in a manner that promotes the migration, wider distribution and the gene pool flow of the species resources. The network aims is maintaining biodiversity and its effective protection of the most valuable and scattered elements of nature, as well as the most typical natural environmental systems for the given biogeographical region.

The subject of the presentation will be the results of the environmental inventory of the Task Planning Practices (TPP - the first in Poland in 2011): Jeleniowo PLH 200001 and 200003 PLH Ostoja Suwalska, in Podlaskie region. The author was the coordinator of the TPP, the final versions are available on the website of the Regional Directorate for Environmental Protection in Bialystok (www.bialystok.rdos.gov.pl). The poster will present the results of the measurements of the diversity of forest ecosystems, with particular emphasis on the protection and conservation of their objects and the categories of FV (as appropriate), and risks from the local conditions and the degree of human impact. At the same time there will be presented the conclusions of the three series of meetings with local communities at different stages of introduction of TPP.

P2 - ASSESSING PAST DYNAMICS OF C3 AND C4 DOMINATED GRASSLANDS: A NOVEL APPROACH USING POACEAE POLLEN MORPHOLOGY

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Grassland ecosystems cover about 25% of the Earth's surface. For understanding modern grassland ecosystems, their transformations due to human impact and their responses to global change, the history of these ecosystems needs to be studied. Since the long-term dynamics of grasslands are rather difficult to access by palynology, in this study we investigate to what extent pollen morphology of Poaceae can be used to assess past grassland ecosystems. Of particular interest is the composition of C3 and C4 Poaceae species in different grasslands as they can be interpreted as climate proxies for past temperature and precipitation variation. Therefore, the focus of this pilot project is to find out whether C3 and C4 Poaceae species from different regions can be separated by their pollen grain size. During field visits in northern Pakistan, we collected 70 C3 and C4 Poaceae species at low, mid and high altitude grasslands (280-2600 m a.s.l). Furthermore, we studied pollen material of 35 Poaceae species from Tanzania, 24 from South America and 30 from Germany. 160 Poaceae species were prepared for pollen grain size analysis using standard methods. We measured four pollen parameters: pollen length, pollen width, pore diameter and annulus thickness, using Leica Photo Microscope and the accompanied image analysis software Leica QWin. C4 species reveal higher average values of pollen length (36.1 µm), pollen width (32.5 µm), pore diameter (2.7 µm) and annulus thickness (2.3µm) while C3 species reveal lower average values of pollen length (33.1 µm), pollen width (29.7 µm), pore diameter (2.4 µm) and annulus thickness (2.3 µm) respectively. Statistical analysis (Shapiro Test) reveals that measurements of the four pollen parameters in C3 and C4 datasets show Gaussian distribution ($P > 0.05$). T-Test and Wilcoxon Test reveal differences in the pollen parameters at different levels of significance ($P \leq 0.1$). We conducted Principal component analysis (PCA) of the whole dataset. All the four pollen parameters show increasing response to C4 anatomy and decreasing response to C3 anatomy confirming the outcomes of our statistical tests. Our pilot study

shows that the differences of pollen grain size can be used to distinguish fossil or sub fossil pollen deposited in environmental archives to indicate a shift in the C3, C4 Poaceae composition of grasslands during the past.

P3 - DEVELOPING A FRAMEWORK FOR MONITORING COASTAL HABITATS USING AERIAL IMAGERY AND OBJECT-BASED IMAGE ANALYSIS

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Denmark contains major areas of coastal habitats, including a significant part of the European area of coastal dunes and salt marshes. The natural dynamics in coastal habitats are a prerequisite for the maintenance of their structure and biodiversity, yet very little research on the implications of decreased habitat dynamics exists. A valuable source of land cover changes is historical aerial imagery of which Denmark has unique data sets. This poster presents an object-based image analysis approach for mapping and monitoring of coastal habitat structure, which integrates the high spectral resolution and consistency of satellite imagery, with the high spatial resolution of aerial imagery.

Session B2- Grazing effects on biodiversity and/or ecosystem services

Chairs: **J. Mantilla-Contreras¹ & S. Zerbe²**

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Grazing by large herbivores has several direct and indirect effects on biodiversity, ecosystem properties and -services. These effects can be either positive or negative depending on the intensity of grazing and on environmental conditions. Negative effects occur mainly in intensively or overgrazed areas and lead to biodiversity loss, changes in species composition, soil erosion and water pollution. Positive effects are mostly achieved when grazing is extensive or intermediate. In such case, grazing enhances biodiversity, promotes the occurrence of specialized and/or rare plant and animal species and regulates several ecosystems functions (e.g. nitrogen availability). Extensive grazing can be a tool to maintain or restore open landscapes and is often essential to achieve nature conservation in wild and semi-natural environments.

In this session, we will discuss the relationship between large herbivores, plant and animal communities, biodiversity and/or ecosystem services, in natural, semi-natural and man-made ecosystems. We welcome contributions that focus on all types of grazed ecosystems including boreal, temperate, arid, tropical and Mediterranean areas.

01 - INDUCED CHANGES IN VEGETATION: AN ESTIMATION OF THRESHOLDS

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For low-productivity ecosystems many management methods have been discussed, e.g. mowing, grazing or burning. Among them, grazing is, besides forestry, the key to a typical alpine cultural landscape and has also turned out to be an effective tool of nature conservation, management and restoration for semi-natural ecosystems, being proved in various studies. For reducing unwanted species, targeted grazing (also called mob stocking or prescribed grazing) is the use of livestock with a defined duration and intensity to reach a defined goal with vegetation.

The most obvious grazing effect is the selective phytomass extraction by the herbivores pastured, but not only eating, also trampling and relocation of nutrients caused by grazing, turn out as major drivers for change in the vegetation, most prominently species diversity and abundance of species.

The study area of the work presented lies in Austria, federal state of Styria, in the town Haus im Ennstal (47.41° N, 13.78° E). The trial site was an abandoned high pasture, where dwarf shrubs (*Vaccinium myrtillus*, *Vaccinium vitis-idaea*, *Vaccinium gaultheroides*) became dominant. Starting in 2008, a paddock was installed, pastured with sheep following a plan for targeted pasturing. This trial was part in a larger national project, in partnership with a local sheep breeder association.

The set up was a factorial design with four levels, with four replicates: No treatment/pasturing (exclosure), one time mowing of dwarf shrubs, followed by high intensity pasturing, high intensity pasturing and low intensity/browsing. Based on vegetation surveys done between 2008 and 2011 with a quadrat, the rate of change in the cover of dwarf shrubs was calculated and correlated with the cumulated LAU per hectare and year pastured (LAU: Large Animal Unit, equals to 500 kg live weight). Using the linear regression equation ($y = -0.2432 \cdot x + 1.0875$, adjusted R-squared: 0.43), setting the rate (y) to 1 (no change) and solving it for x (LAU/ha*a) brings the minimum amount of LAU needed to cause a decrease in cover. Comparing the different variants, it can be concluded that after a first strong impact of around 1 GVE/ha*a within a short period of time, followed by pasturing with at least 0.4 LAU/ha*a for three to four years, cover of dwarf shrubs can be reduced from around 40% to around 5%. Based on a habitat mapping and a GIS, it was possible to interpolate the grazing impact over larger areas in the study area with these parameters. The results help to give solid management recommendations for the area for sustaining an open cultural landscape, base for additional sources of income like tourism and limiting the impact of the low-quality feed for the sheep.

O2 - IMPACT OF GRAZING MANAGEMENT AND DISTANCE FROM FARM BUILDING ON ORTHOPTERAN AND BUTTERFLY DIVERSITY IN ALPINE SUMMER PASTURES

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Alpine summer pastures have evolved over centuries through the adaptation of human activities to harsh climatic and topographic conditions and constitute an integral part of the natural and cultural heritage. In the Italian Alps, these transhumance systems involve the seasonal movement of livestock, mostly dairy cattle, from the agricultural land in the valleys to the mountain pastures during summer. These species-rich summer pastures have a high conservation value and provide a number of services to farmers and society. There is evidence that their long-term maintenance is inextricably linked to the continuation of traditional low-intensity grazing.

During recent decades particularly dairy farming has experienced a change towards concentration on fewer and larger farms, accompanied by higher cattle stocking rates. In order to increase milk production, traditional breeds of livestock have been largely replaced by intensive dairy cattle breeds and supplementary feeding with high energy concentrates has been widely introduced. These trends towards intensification and specialization are likely to have a strong impact on vegetation structure and thereby on insect diversity in Alpine summer pastures.

In this study, we investigate the impact of grazing management and distance from farm building on orthopteran and butterfly diversity in Alpine summer pastures. Grazing management of summer pastures differed in terms of type of livestock (dairy cows vs. heifers) and stocking rate. Because Alpine summer pastures often cover large areas consisting of a heterogeneous mosaic of open grassland, exposed bedrock and patches of forest or dense shrubs, species richness of orthopterans and butterflies was sampled at three different distances from the farm building to account for different intensity of trampling on insect diversity. To test the effects of distance from farm building and stocking rate on insect diversity, we surveyed a total of 15 Alpine summer pastures that differed in type of livestock.

Our results revealed a significant interaction between distance from farm building and type of livestock for both insect groups. Species richness of orthopterans was lower close to the farm building than far away if grazed by dairy cows, while there was no distance effect if grazed by heifers. Species richness of butterflies was lower if grazed with heifers than with dairy cows. This negative effect was stronger for the plots distant from the farm building. Stocking rate negatively affected species richness of butterflies but not orthopterans, irrespective of the type of livestock.

Our findings indicate that orthopterans are highly sensitive to trampling by heavy cows and increased grazing pressure nearby the farm building, whereas butterflies are more sensitive to changes in vegetation composition and the removal of nectar producing plants induced by a higher herbage intake and a higher grazing activity of heifers.

O3 - SOCIAL AND ECOLOGICAL FEASIBILITY OF RANGE MANAGEMENT RECOMMENDATIONS FOR THE JAVAKHETI HIGHLAND, CAUCASUS

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Against the background of the political and social changes after the break-down of the Soviet Union during the 1990s, one of the main threats for the unique ecosystems in the Caucasus region is the current critical economic situation of the rural population. The post-soviet privatization of agriculture is considered as determinant for strong land-use changes in the mountain areas. Throughout the whole Caucasus mountains, unregulated and continuously intensified grazing has been resulting in the loss of biodiversity and in habitat destruction. Thus, several pasture management plans have been drafted especially for protected areas. Due to weak legal regulations, insufficient financing and the lack of acceptance by land-users, these plans have not yet been implemented. Hence, how can integrative anthropological and ecological research contribute to feasible range management recommendations for high mountain pastures of the Caucasus region? The scope of our

interdisciplinary BIOMAN-project is commonly and privately used pastures within different zones of the recently established Georgian Javakheti National Park. The area is highly diverse, for one thing as part of the Caucasian Biodiversity Hotspot and for another thing as an encounter of the three major ethnic groups of the South Caucasus. The ecological inventory of the current pasture condition is based on 97 vegetation plots and extensively mapped by remote sensing techniques. The underlying grazing pressure is quantified by spatial temporal assessment of different representative grazing systems including local perception, knowledge and motivation. Applying participatory observation and different interview techniques, the analysis of stakeholders and local land-use practices are the bedrock of a consequently participatory approach. This is targeted on the cooperative development of pasture and resource management strategies with local actors. Despite of the opinion of the local organization and current policymakers, we have not yet been able to proof that the study area is generally overgrazed. In fact there is a huge variety of different pasture stocking rates, conditions and thus carrying capacities. Due to the less steep topography, strong areal erosion mainly occurs on daily used cattle tracks. Among several discovered grazing practices, we were able to distinguish two types of key stakeholders with different herding practice and motivation: on the one hand long-term shepherds knowing the local circumstances very well and on the other hand short-term shepherds driving their flocks by accident. Our consideration starts right with this polarity of local knowledge. Scientific methods and knowledge could serve as transport media to bundle and communicate local knowledge. By this transdisciplinary approach we aim at recommendations for a sustainable range management.

O4 - HOW DOES GRAZING INFLUENCE THE BIODIVERSITY OF THE NATIONAL PARK ASINARA (SARDINIA, ITALY)?

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Biodiversity is endangered throughout the world, particularly by unsustainable land use. Through intensive land use coupled with climate change, regions with high biodiversity like the Mediterranean area need special attention. High biodiversity is characteristic for areas which provide a variety of habitats. This variety depends on abiotic (e.g. topography, soil, hydrology) as well as biotic factors like the area's species pool or grazing. Grazing might even be a key factor for the conservation or maintenance of biodiversity. However, intensive grazing or the introduction of alien ungulates may threaten the biodiversity and the survival of endangered plant and animal species, particularly in isolated ecosystems like islands. In the Mediterranean region, the Italian island of Sardinia is one of the regions with the highest biodiversity, especially of the flora. However, it is also considered as one of the ecologically most vulnerable ecosystems.

In the Northwest of Sardinia on the island Asinara (52 km²), 700 plant species have been recorded and this high diversity can be attributed to its highly structured landscape, different soil types and grazing animals such as, e.g., horses, donkeys, and mouflons. In our project, we investigate in an interdisciplinary team the impact of grazing on the diversity of plants based on the given soil and relief in the National Park Asinara by obtaining the distribution of the main vegetation types, their composition and potential of soil. Additionally, we assess grazing preferences regarding grazing areas and fodder plants. Also, the population sizes and the regulation of the livestock in the National Park have to be considered in order to evaluate the impact of grazing. We will introduce our project and present first results of the field work. Additionally, we address possible constraints of a young National Park, e.g. by touristic activities and related to the land-use history (prison until 1997). Based on our research, we will derive recommendations for a comprehensive development, management, and protection concept for the National Park of the island of Asinara.

O5 - CONVERSION OF HUMID SAVANNA INTO AGRO-ECOSYSTEMS: IMPACTS ON SPECIES COMPOSITION, CARBON DIOXIDE EXCHANGE AND CARBON STORAGE IN THE HERBACEOUS VEGETATION

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Savanna vegetation are experiencing significant decline in biomass and biodiversity as a result of a combination of biophysical processes linked to climate change (frequent and prolonged droughts) and human activities involving vegetation clearing and overgrazing. The struggle between maintenance of savanna quality on the one hand and the persistence of most of its functions and interests for people on the other hand require that we understand and characterize the change processes and their driving forces as well as the ecosystem capacity for resilience. Lambwe valley in south-western Kenya has a lush humid savanna island lying adjacent to lake Victoria, just a few kilometers from the equator (34°10' and 34°20'E; 0°30' and 0°50' S), with a total land area of approximately 324 Km². It has experienced significant environmental challenges during the last 50 years. We report results from a series of studies conducted between 2009 and 2012 to examine the impacts of conversion of natural savanna into an agro-ecosystem involving livestock grazing and crop cultivation. Soil moisture, Carbon dioxide (CO₂) exchange, productivity and species composition of the herbaceous vegetation were examined in adjacent fallow crop field, open grazed- and fenced plots where grazing has been excluded since 2006. Ploughing had the strongest impact on species composition of the herbaceous vegetation. Surprisingly, soil carbon (C) concentration remained relatively stable, even after 20 years of crop cultivation. Ecosystem respiration in the herbaceous layer was also not affected by land use. Seasonal fluctuations in net ecosystem CO₂ exchange (NEE), ecosystem respiration (Reco) and gross primary production (GPP) were attributed to differences in soil moisture. GPP was lowest in the grazed plots, but the vegetation here exhibited the highest photosynthetic efficiency. The vegetation in the fallow crop plots were more responsive to soil moisture changes and are more likely to suffer most from drought. Grazing suppresses the herbaceous vegetation to operate below their maximum potential for CO₂ uptake.

O6 - FLORISTIC DIVERSITY AND VEGETATION ANALYSIS OF WADI AL-NOMAN, HOLY MECCA, SAUDI ARABIA

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Wadi Noman in Mecca is one of the most important wadis. It was included in the most important water sources where the spring and wells of Zobida were running. It was providing the holy places in Mecca with drinking water for visitors of Kaaba and Arafat regions. The present study provides an analysis of floristic composition, vegetation types as well as structure and species distribution of 20 sites, emphasizes on the environmental factors that affect the species distribution. A total of 126 species representing 39 families of the vascular plants are recorded. Fabaceae, Poaceae and Boraginaceae are the largest families. Therophytes and chamaephytes are the most frequent, indicating a typical desert life form spectrum. Floristic composition in the different geomorphologic landscape units showed differences in species richness. The highest species richness of (23 ssp. stand-1) is recorded in the wadi bed. The lowest species richness value (18 ssp. stand-1) is recorded in the wadi plateau and fissures. Chorological analysis revealed that 52% of the studied species are biregional, being native to the Saharo Arabian-Sudano Zambezian region. Four vegetation groups were identified after application of TWINSPAN, DCA and CCA programs and named after the characteristic species as follows: (I) *Aristolochia bracteolata*-*Cucumis prophetarum*; (II) *Calotropis procera*-*Acacia hamulosa*-*Caralluma russeliana*; (III) *Acacia abyssinica*-*Acacia hamulosa*-*Tephrosia desertorum* and (IV) *Argemone ochroleuca*-*Senna italica*. These plants associations and speciation of Wadi Noman demonstrate significant variation in pH, EC, soil mineral contents and human impacts.

P1 - INFLUENCE OF GRAZING, SOIL, RELIEF AND CLIMATE CHANGE ON THE BIODIVERSITY IN THE NATIONAL PARK OF ASINARA (SARDINIA, ITALY)

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The Mediterranean region is one of the 25 biodiversity hotspots throughout the world. Containing 4.3% of the global plant species it features the highest biodiversity in all over Europe. Within this region the Tyrrhenian islands, including Sardinia, have a particularly high species richness, especially considering the flora. Today unsustainable land use coupled with climate change is a severe factor threatening this diversity.

Used as pastureland for centuries and being a prison colony for decades, the Italian island of Asinara in the Northwest of Sardinia was widely influenced by grazing, farming and raising of livestock. After becoming a National Park in 1997 the land use systems were abandoned, leaving a distinct landscape with an exceptional high biodiversity, extremely valuable for nature conservation. On an area of 52 km² more than 700 plant species have been recorded. This high plant diversity is the result of a variety of habitats that depend on abiotic (e.g., topography, soil, hydrology) as well as biotic factors like the influence of different grazing animals, such as horses, donkeys, goats and mouflons, which have shaped the vegetation structure of the island for a long time.

Using the example of the island of Asinara, our interdisciplinary research group is studying the correlations between climate, pedosphere, relief, grazing and biodiversity on Mediterranean ecosystems and possible changes under the projected climate change. We investigate the distribution of the main vegetation types, the plant composition, structure and plant traits, as well as the occurring soil types and their characteristics. Furthermore, the population densities of the grazing animals regarding their preferences for grazing areas and fodder plants are observed. Additionally, subprojects are integrated, targeting issues like the composition of ground beetle species or the abundance of bats in dependency of different habitat types. Based on our research, and in cooperation with the National Park authority, we aim to make a contribution to the management and maintenance of this young National Park, considering factors like the regulation of feral animals of domestic species, the conservation and restoration of the native flora and fauna and the development of tourism in view of a future climate change.

We will present the structure of our research project, the setup of the ongoing studies and analyses and give a brief look on first results of the field work.

P2 - THE PASTURE AND DUNE FACIES OF VEGETATION IN THE REGION OF TLEMCCEN (WESTERN ALGERIA)

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This study is devoted to the analysis of the vegetation of coastal dunes in the region of Tlemcen. Results were obtained on these in general, including the biological and ecological. These results allowed us to individualize different phytosociological classes: The Cakiletea maritimae and Ammophiletea for cash at the beach; the Thero-Brachypodietea and Quercetea ilicis in the sand dune and fixed dunes. Class Cakiletea maritimae and Ammophiletea grouped species of embryonic dunes. Thero-Brachypodietea class includes species of sand dune. The class of Quercetea ilicis includes species of the dunes most advanced and most determined. Using phytosociological data and plant dynamics, we understand the evolution of the vegetation and its diversity.

P3 - IMPACT OF VEGETATION REMOVAL ON SOIL PROPERTIES IN A MOIST KENYAN SAVANNA

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In savanna ecosystems spatial heterogeneity consisting with small patches of grasses, trees, and crops is usually high and are mostly due to human activities such as grazing by large animals and crop cultivation. Modified plant composition and density due to land use practices consequently alter soil properties, plant water use and productions. To analyze the effects of the vegetation covers due to grazing and crop cultivation on soil properties we selected three study plots according to the degree of the vegetation removal, i.e., 100% removal (crop production), 50% removal (grazing by domestic animals), and 0% removal (non-grazed/fenced in 2006). At all study plots, 0.8–1 m soil profiles were excavated and 3 soil samples were collected from each soil horizon using soil core rings (2.8 cm in diameter and 1 cm in height). From these samples, soil structures, bulk density, pH, C, and N contents were determined in the lab. We also measured soil water contents, taking additional soil samples with soil core rings at three different layers of 0–10, 10–20, 20–30 cm and plant biomass and plant species composition, selecting four sub plots (38 cm × 38 cm) in each plot. Soil texture of the 0% and 50% removal plots was clay, while 100% removal plot was silty clay based on the FAO soil texture classes. Bulk density was 0.8–0.9 g cm⁻³ at the 0% and 50% removal plots, and 1.0–1.1 g cm⁻³ at the 100% removal plot. Soil water content, N and C contents were higher at the 0% removal plot than the other plots. Dominant grass species at the 100% and 50% removal plots was *Themeda triandra*, occupying more than 90% of the plot. These results support the hypothesis that the vegetation removal influences the heterogeneity in soil properties and, therefore, likely the capacity of plant water use and production.

P4 - SEED DISPERSAL BY HERBIVOROUS UNGULATES IN ABANDONED LANDSCAPE

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Free-ranging herbivores are an essential part of landscape in Central Europe. Their impact on vegetation is a highly complex system from which certain parts are yet to be clarified. Our group focuses on direct effects of herbivores' presence – such as grazing – as well as the less obvious ones, e.g. trampling and assisted seed dispersal. Our study is being conducted in abandoned landscape of Military Area Hradiště in the Doupov Mountains in western part of the Czech Republic. Here we are interested in three species of herbivorous ungulates: red deer (*Cervus elaphus*), sika deer (*Cervus nippon*) and wild boar (*Sus scrofa*). Dung pellets collected throughout the season were examined and viable seeds were determined using seedling emergence method. Preliminary results were obtained by manual extraction of seeds.

We have discovered significant differences between the two methods used for determination of seeds probably due to small number of samples that were manually extracted. Nevertheless, studied herbivores proved themselves to be highly effective seed dispersal vectors in numbers of seeds and in numbers of transported species as well. High numbers of several species have been found, for example *Urtica dioica*, *Fragaria sp.*, *Veronica chamaedrys* and *Galium mollugo*. We have discovered strong seasonality in both species composition and the numbers of diaspores which were both influenced by the producing animal as well. The latter indicates species of herbivorous ungulates are not equal in their role as seed dispersers as is often accounted for.

P5 - THE EFFECT OF GAME GRAZING ON THE WATER COMPETITION BETWEEN ACACIA MELLIFERA SHRUB SEEDLINGS, ADULT SHRUBS AND PERENNIAL GRASSES IN SEMI-ARID SAVANNAS IN NAMIBIA

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Shrub encroachment due to unsustainable livestock management in combination with highly unpredictable climatic conditions is considered as the most threatening form of rangeland degradation in African savannas. The increase of woody shrubs and the reduction of palatable vegetation diminish the carrying capacity of the rangeland and therewith the economic output of livestock farmers. It is an ongoing debate to which extent vegetation structure in savannas is based on the interplay of trees and grasses in competition for water, especially during the phase of establishment of woody encroachers. In the aim of revealing causes and consequences of shrub encroachment from an ecohydrological view and to understand the link between habitat and vegetation characteristics, a study along a degradation gradient in the Kalahari savanna rangeland of the Omaheke region in Namibia was conducted. In this region water availability and the competition for water are important limiting factors. Therefore, mechanisms of interaction among plants are best understood by considering traits which are associated with higher competitive ability regarding water. We compared leaf water potential and other plant functional traits of shrub seedlings in three habitat & vegetation types at small scale with different water competition regimes (inter-, intraspecific and no direct water competition). The results indicate a favoured establishment of *A. mellifera* shrub seedlings with increasing rangeland degradation and are supporting the state-and-transition concept for savannas. It predicts hardly feasible regeneration of once degraded systems linked to a reduction in biodiversity and productivity for livestock farming.

P6 - FACTORS AFFECTING GRASSLAND VEGETATION ALONG AN ALTITUDINAL GRADIENT IN CENTRAL GREECE

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Grasslands are an important land use of Greece, occupying more than 30% of total rangeland area mainly located at high mountains. They have basic role in animal feeding, provide important regulating ecosystem services and support biodiversity. The aim of the study was to determine the effect of grazing intensity and environmental variables on plant species distribution in grassland ecosystems of the Mediterranean region.

The research was conducted on Othrys mountain, located at the eastern area of Central Greece and three grasslands were selected at altitude ranges between 800 – 1000 m, 1000 – 1200 m and 1200 – 1500 m. The climate of the area is classified as sub-Mediterranean, with cold, moist winters and warm, dry summers. All grasslands were subjected to grazing by three animal species (cattle, sheep and goat) for a long time but with different stocking rates. Grasslands at 1200-1500 m altitude were grazed at a stocking rate of 1.7 cattle ha⁻¹ while in the other two altitude ranges stocking rate was 2.7 cattle ha⁻¹. Three experimental areas 50x50m were selected randomly in each grassland and vegetation cover and composition were recorded using the line intercept method. Also, species richness was measured and a) diversity index Shannon – Weiner and b) Equitability were calculated. Soil samples were collected at 20 cm depth and soil properties were determined using common pedological methods. All data were performed Redundancy analysis (RDA) using CANOCO software, version 4.5. Monte Carlo permutation tests were used to determine the significance of environmental variables.

Plant species distribution showed distinct differences on ordination diagram depending on grazing intensity. Species distribution produced strong correlations with altitude and soil variables (nitrogen, phosphorus, texture properties). Furthermore, species diversity index increased by 25.8% along altitude gradient. The results revealed that grazing intensity plays a key role in shaping plant distribution together with the environmental factors in grasslands of Central Greece. Moderate grazing intensity is an effective management strategy to maintain biodiversity at higher altitudes of the Mediterranean region.

P7 - OCCURRENCE AND ACTIVITY PATTERNS OF BATS IN DIFFERENT HABITAT TYPES IN THE NORTHERN PART OF THE ISLAND OF ASINARA (SARDINIA, ITALY)

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In general bats need highly structured areas for hunting and roosting. A mixture of forest, semi-open and open habitats in combination with water bodies usually leads to a high activity of bats consisting of high species richness. In many parts of Europe grazing modifies the shape of the landscape into mainly open habitats. With this study we try to assess the abundance of bats in areas which are dominated by these structures. The Italian island of Asinara protected as a National Park is characterized by a low vegetation (Macchia and Garigue) formed by a large number of grazing animals. Based on these circumstances, Asinara can be used for studying the bat activity in dependency to the vegetation structure. For this study four habitat types characterized by different vegetation composition and spatial structures were chosen. We defined "forest" as the type with the highest density due to the abundance of many trees. The "semi-open" habitat contains shrubs and scattered trees whereas in the "open" habitat neither shrubs nor trees can be found. The last habitat is the "(former) settlement" and is characterized by old buildings, street light and some trees or shrubs. For each type of habitat, four representative study sites were selected on the northern part of the island and recordings were done from June until the end of August 2013. Each night the bat activity was recorded on a different study site with a bat detector (EM3+). Additionally, we selected insects simultaneously to the recordings to verify if the bat activity correlates with the amount of prey. The data should give an overview of the number of bat species on Asinara and their activity in different habitat types. Furthermore, we investigate the influence of the habitat structure on each species to identify "specialist" and "generalists". At this stage, seven species were found due to the acoustical analysis and a different general activity between the chosen habitat types can be assumed.

Session F1 - European wood-pastures in transition

Chairs: **A. Peringer**¹, **S. Siehoff**², **T. Hartel**³, **S. Tischew**⁴, **F. Gillet**⁵ & **G. Rosenthal**⁶

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Wood-pastures are important elements of European cultural identity and play a crucial ecological role both at local and landscape scale, but are in decline all over Europe. The major drivers of this decline are related to accelerated cultural, institutional and socio-economic changes, which occurred across Europe during the past century. Agricultural intensification on the one hand and abandonment on the other led to dramatic changes from multi-functional heterogeneous landscapes towards more monotonous and mono-functional landscapes. Subsequently extensively-used semi-natural landscapes diminish. Particularly the pasture-woodlands are threatened by a segregation of land-use, which leads to the spatial and functional isolation of large patches of intensively used (treeless) grasslands from forests. The decline of wood-pastures comes with the loss of the rich and specific biodiversity of patchy landscapes, resilience and adaptive potential of populations, communities and ecosystems to cope with climate change. Today, the remaining wood-pastures are ecosystems of high conservation value, because (i) they serve as refuge habitats for threatened species, which depend on extensive land-use forms, (ii) they show a high adaptive potential to global change, (iii) for recreation and (iv) for being a pan-European cultural heritage. Furthermore, silvopastoral systems are among the most promising approaches for sustainable management of open landscapes all over Europe.

The goal of this session is to bring together people with wide variety of expertise's (e.g. ecology, social sciences, economy, institutions and policy) regarding the wood-pastures from various countries in Europe. This will provide a unique and needed platform for the discussion and synthesis about the existing knowledge on diverse forms of wood-pastures across Europe, their ecology, socio-economy, threats and conservation possibilities, including their integration into funding guidelines of the Common Agricultural Policy. This synthesis will build on the numerous contributions to the vivid wood-pasture blog currently hosted by the *Society of Conservation Biology*.

O1 - DRIVING FORCES OF THE HUNGARIAN WOOD-PASTURE MANAGEMENT IN THE LAST 200 YEARS

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Currently in Hungary approximately 5500 ha of wood-pasture can be found. This extension now appears small compared to its former significance, which the historically land use data show most convincingly. The aim of our work is to reveal background factors which define the present expansion and state of wood-pastures. We have examined forestry and agricultural studies of the last 200 years. Furthermore, we collected field data of the vegetation and land use type of 43 abandoned and managed wood-pastures across Hungary. During our work we did semi-structured interviews with local people, herders and rangers of the National Park. Like in other parts of Europe the key driver of the change that has affected wood-pastures is industrialisation. Since the 18th century timber production has been put in the centre of forestry management to cover the growing demand for energy. This type of forest management has resulted in the fall-back of traditional multifunctional forest management. This tendency and the industrialisation of agriculture also caused the decline of traditional animal husbandry. In Hungary, one of the most influential laws was the Forest and Pasture Separation Act in 1853. As a result, the size of pastures was decreased and forest grazing rights become limited. At the end of 19th century a pasture crises took place all through the country. In order to solve this problem the creation of wood-pastures was supported by the forestry agency. The next important change was the collectivization of the pasture and forest by the Soviet agricultural system from the 1950's until 1989. During this time not only the grazing rights were limited, but the right of owning the land was taken away from local farmers. This resulted in their lack of interest of managing wood-pasture in a sustainable way. The previously well-planned and conscious wood-pasture management was discontinued, for example shrub cleaning almost entirely got stopped. Consequently afforestation processes started in wood-pastures which got promoted by the decrease of livestock in number, too. Another problematic result of the management during the Soviet regime was a short-term endeavour to gain wood by cutting large trees and so turning wood-pastures into arable land. Over the past few years restoration and new creation of

wood-pasture have started in order to gain subsidies or because of nature conservation reasons. The interest of farmers and conservationist has grown in the practical side of the use of traditional pasture bringing back traditional ecological knowledge. Land use based on traditional knowledge highlights the importance of the mosaic and dynamic landscape as opposed to categorization and the static type. This traditional kind of approach could improve sustainable wood-pasture management in the future. The history of the Hungarian wood-pasture proves the dependence of this special habitat on human attitude and care.

O2 - ERASING A EUROPEAN BIODIVERSITY HOT-SPOT: FORESTRY INTENSIFICATION AND SUCCESSION TURNS OPEN WOODLANDS INTO FOREST PLANTATIONS IN UNESCO BIOSPHERE RESERVE

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Open woodlands are biologically the richest habitat of temperate Europe that, however, nearly disappeared from the continent. Their original cover and magnitude of their loss remain mostly unknown. Here, we document the story of transition of open pasture woodlands into forest plantation, quantify the loss of open woodlands and assess the potential for their restoration in an internationally protected biodiversity hot-spot, floodplain woodlands of lower Thaya and March rivers of Dolní Morava UNESCO Biosphere Reserve in Czech Republic.

Aerial photographs from years 1938 and 2009 and forestry maps were used to analyze changes in forest canopy closure and in forest age structure for the area of 146 km². We also compare the changes in nature reserves and non-protected land. Between 1938 and 2009, expansion of closed-canopy forest reduced open woodlands cover from 41% to 5.7% of total wooded area, or 68.5% to 14.1% in the state reserves respectively. Logging has led to a decrease in mature forest cover from 45% to 26% between 1990 and 2009. State reserves prevented logging, but not open woodlands loss.

The magnitude of open woodlands loss parallels that of tropical habitats, but has gone unabated even in nature reserves. Chances to restore open woodlands and conserve associated biodiversity in the internationally protected (e.g. UNESCO, Natura 2000), mostly state-owned, woodlands are being compromised by rapid logging and lack of understanding on side of nature conservation. Our results point to the low ability of post-communist EU-members to conserve their biodiversity.

O3 - TRADITIONAL WOOD-PASTURES IN SOUTHERN TRANSYLVANIA: CHARACTERISTICS, BIODIVERSITY AND THREATS

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Wood-pastures are an ecologically and culturally important landscape element and known for their high biodiversity. Once, this kind of land-use was widespread all over Europe, but has declined drastically in northern Europe over the past several centuries. Nevertheless, they are still common in south and east Europe. In this study we aim to gain a deeper insight into the diversity, biodiversity and conservation status of wood-pastures in this traditional rural region in Southern Transylvania, Romania. Southern Transylvania is a region rich in wood-pastures, which are still used in an extensive way for grazing but face a variety of threats. We first characterized the tree and scrub structure and diversity of wood-pastures (n=42) compared to forests (n=15) and investigated the major threats for wood-pastures. Second, we compared the occurrence of 6 woodpecker species between forests (n=12) and wood-pastures (n=28) and assessed which features of the wood-pastures determine woodpecker occurrence for three species protected under the EU Bird Directive Annex I. Third, we surveyed bear activity in 54 sites to assess the importance of wood-pastures as habitat for the brown bear (*Ursus arctos*).

Wood-pastures were dominated by oak trees (*Quercus sp.*) and various species of fruit trees. Wood-pastures contained more large trees compared to forests. Moreover, thirty-three wood-pastures contained ancient trees (Farm Environment Plan Guide (2006): Dbh ≥ 75 cm for hornbeam, ≥100 cm for oak and ≥150 cm for beech),

whereas no ancient trees were found in forests. Major threats are illegal burning management and scrub clearance to receive subsidies for the area. Wood-pastures provided important additional habitat for woodpeckers including protected species. Woodpecker composition, but not the number of species, differed between forests and wood pastures. Bear activity was observed in 87% of the wood pastures indicating the high usage of wood-pastures by bears.

Our study shows that ancient wood-pastures are common in Southern Transylvania but threatened by burning and a lack of regrowth. Our results suggest that traditional wood-pastures provide valuable habitat for several forest species, such as woodpeckers and bears, which are threatened in many other parts of Europe.

To conserve European wood-pastures we suggest they be explicitly considered in two major EU policies: (1) the EU Habitats Directive; and (2) the EU Common Agricultural Policy, specifically with respect to agri-environment payments.

O4 - EXPLORING THE LINKS BETWEEN FOREST TRANSITION AND LANDSCAPE CHANGES IN THE MEDITERRANEAN. CAN FOREST RECOVERY LEAD TO LOWER LANDSCAPE QUALITY?

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A forest transition occurs when the total forest cover of a given country or region starts experiencing net gains after a historical period of net losses. As economic development unfolds and non-farm jobs increase, rural out-migration fosters the abandonment of marginal croplands –which are later afforested or reforested. A growing number of studies argue that forest transitions should be enhanced by policymakers given its potential benefits, for instance in slowing climate change through carbon sequestration. Yet the effects of forest transition(s) in landscape and biodiversity remain poorly understood. In this paper we explore the interrelationship between the forest transition experienced by one particular Mediterranean mountain area –located in the Catalan Coastal Range within metropolitan Barcelona– and the landscape changes occurred therein. Three detailed land-use maps of the study area were built from the cadastral cartography, available for years 1856, 1954-56, and 2013. Several metrics on intensity of land-cover change, landscape structure, and landscape functioning were calculated. Demographic dynamics were reconstructed with data from local censuses, and interviews to local peasants were conducted to know the land management practices performed by the community. Multiyear data on butterfly assemblages from two transects was used as indicator of land-use change effects in biodiversity. Results show a clear process of forest expansion –both spontaneous and planted– in former cereal fields, vineyards and pasturelands along with rural out-migration and land abandonment. Such forest transition involved large changes in landscape structure and functioning. As the peasant management of integrated agrosilvopastoral systems disappeared, landscape became less fragmented and less diverse. Even if forest area is now larger than in mid 19th century, ecological connectivity among forest areas did not substantially improve. Instead, ecological connectivity among open habitats has greatly decreased as cereal fields, vineyards, meadows and pasturelands have almost disappeared. Spatiotemporal evolution of butterfly assemblages under changing land-uses highlights the importance of cultural landscape mosaics for biodiversity conservation. Our work emphasizes that the conservation of landscapes with a long history of human use –such as those in the Mediterranean– needs to take into account the role of socio-metabolic balances in shaping ecological features and biodiversity. Hence the suitability of forest transitions should be critically examined in relation to context and policy objectives.

O5 - SHRUBS IN PASTURES ENHANCE VEGETATION HETEROGENEITY

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The outstanding structural diversity in pastures with scattered trees and shrubs implies strong effect on vegetation heterogeneity (beta diversity). Therefore, it is very surprising that there is so little information on the species richness and variability of either wood- or shrub-pastures. Particularly the effects of the interactions between shrubs and grazing are often overlooked.

We investigated shrub pastures in Romanian Banat, where the people still manage the landscape in a traditional way. Pastures are grazed by cattle, horses, sheep, and goat. Pastures are also used to grow fruit trees. Further, shrub-like beeches and hornbeams are coppiced for fuel and unusable shrubs are from time to time burned to improve the pastures. This management generated heterogeneous mosaics of scattered or dense shrubs and grasslands. We asked the following questions:

1. Do shrubs influence plant species beta diversity on the small spatial scale?
2. Depends alpha and beta diversity on the grazing intensity?
3. Does interaction between shrubs and other environmental factors influence vegetation or diversity of plants?

We wanted to cover the whole variability of shrub cover and grazing intensity and also small scale variability of shrub cover and environmental conditions. Therefore, we recorded 156 vegetation samples in 52 triplets. The samples in triplets were in distance of either 2 or 6 m each to other. On the site of each vegetation sample we measured the shading of each sample by shrubs, the soil depth, aspect, slope, and estimated the proportion of plant shoots bitten by animals. We also counted the number of faecal pellets around the triplet to estimate the frequency of visits by animals.

We found that at the large scale (among triplets) the vegetation composition is significantly influenced by grazing intensity, shading by shrubs, and soil depth. On the small scale, however, only shading is significant. The number of species generally decreases with shading by shrubs on the large scale. However the exact relationship is unimodal with a peak on the sites moderately shaded by shrubs. The situation at the scale of individual vegetation plots is similar. Both the open grasslands and the shrubs host specialized plants. Therefore, we found positive relationship between variation in light conditions and beta diversity. Importantly, the relationship between number of pellets and beta diversity is unimodal.

Our results document that both the grazing intensity and the variability in shrubs significantly contribute to the vegetation variability at different spatial scales. Shrubs are important in pastures as refugia for species demanding shade or for species that are sensitive to grazing. Therefore, the value of shrubs must be considered when managing the pastures.

O6 - ALTERNATIVE LAND USE OPTIONS FOR LARGE SCALE HEATHLAND ECOSYSTEMS

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Calluna vulgaris-dominated heaths and their associated plant communities such as dry basophilic grasslands are widely recognized to be of high conservation value and currently affected by a sharp decline due to the abandonment of traditional and often cost-intensive management. However, constant human intervention by management measures is one of the most important preconditions to maintain these species-rich communities. Although extensive free-range grazing with large herbivores, especially horses and cattle, is known to be an efficient management method to maintain such habitat types more knowledge is needed about the effects on sandy habitats in (sub-)continental regions. In addition, reasonable combinations of free-ranging grazing and other measures are insufficiently studied.

In autumn 2008, a large-scale field experiment on a former military training area in Eastern Germany (Oranienbaumer Heide) with free-ranging megaherbivores (Heck cattle and Konik horses) was implemented to test their effects on heaths, dry basophilic grasslands, small-scale mosaics of both and *Calamagrostis epigejos* stands. In addition, combinations with a onetime cutting management, as well as application of mineral licks were tested in *Calluna vulgaris*-dominated heaths. These treatments were compared with the vegetation development on sites without management. Furthermore, effects of different age stages on the germination ability of *Calluna vulgaris* were studied in growth chambers.

At the beginning of the experiment most of the *Calluna vulgaris* individuals were over-mature due to a 20 year-period of land use abandonment. After the four-year grazing management vegetative regeneration can be mainly

observed in mosaic stands. Onetime cutting in dominant stands enhances the digestibility of *C. vulgaris* and consequently the foraging preference, particularly by Heck cattle. The application of mineral licks increases trampling effects on *C. vulgaris*, causing a significant improvement of the vegetative regeneration. However, all combinations of management did not initiate a considerable increase in generative regeneration. The germination experiments showed no significant correlation between age stages of *C. vulgaris* and germination ability of seeds. Therefore, the limited germination did not result from the mostly over-mature stands in the study area. Other reasons, such as climate change, especially lower spring and summer precipitation, must be considered and will be studied in the future.

Other positive effects of the grazing regime are a considerable reduction of litter material and the creation of bare ground supporting the establishment of rare species. In addition, grazing induced a significant decrease in ruderal species and invasive neophytes such as *Prunus serotina*, reduced grass cover, especially of *Calamagrostis epigejos*, and prevented further grass invasion into heather. Grazing also promoted a distinct increase in breeding territories of birds typical for (semi-) open landscapes, like stonechat (*Saxicola torquata*) or woodlark (*Lullula arborea*).

Due to a comprehensive public relation the project is well accepted in the region. Financing is provided by agri-environmental schemes and regional marketing of the high-quality beef.

07 - WOOD PASTURES IN UPPER BAVARIA - IMPACT OF CHANGED GRAZING ON SUCCESSION AND BIODIVERSITY OF DIFFERENT SPATIAL SCALES

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The nature-conservation value of semi-open wood pastures in Upper Bavaria is currently under threat because the traditional land use, low-intensity grazing of cattle on large common pastures (> 50 ha), is economically no longer efficient for the farmers in this region. Due to fertilization and segregation of land use options the structural diversity of these areas is going to be diminished: Reducing the grazing intensity initializes secondary progressive successions and forest expansion at the expense of semi-open landscapes consisting of grasslands, grazed forests and ecotones connecting these ecosystems. Succession lines and mechanisms are reconstructed especially for the most important FFH-biotopes (e.g. Caricion lasiocarpae, Caricion davallianae) by both applying the "time-by-site-substitution" method and analyzing germination and establishment patterns of trees. Our analyses show that traditional methods of low-intensity grazing is capable of realizing a high structural diversity on different spatial scales (micro- to landscape scale) which, in turn is a prerequisite for an exceptional high biodiversity of these wood pastures.

08 - EPIZOOCHORY VIA THE HOOVES - THE EUROPEAN BISON (*BISON BONASUS* L.) AS A DISPERSAL AGENT OF SEEDS IN AN OPEN-FOREST-MOSAIC

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Seed dispersal is an important process to maintain biodiversity in landscapes. Large herbivores are important vectors for the long-distance dispersal of seeds in various habitats, both attached to animals (epizoochory) and via gut passage (endozoochory). The majority of studies on epizoochory have examined dispersal in the fur of domesticated ungulates. Studies on epizoochory by wild ungulates are important to understand dispersal processes in many habitats, but rare due to methodological constraints. We studied epizoochory of seeds by European bison in an open-forest-mosaic (nutrient poor grassland and heathland, mixed forest) in NW Germany, where bison had been introduced for the purpose of nature conservation. Due to the given conditions at the study site, it was possible to apply a method by which hoof material of moving bison was indirectly collected. We identified a total of 1082 seeds from 32 plant species (79 seeds per 100 g dry mass) in the hoof material. The

three most abundant seed species were *Polygonum aviculare*, *Agrostis capillaris* and *Betula spp.*, respectively. There was a large heterogeneity in seed morphology and plant species traits. Seeds originated from various biotope types of the study area, while the majority of seeds derived from trampled areas. Compared to the background vegetation, dispersed plant species had a higher seed longevity index, indicating that many seeds were picked up from the soil seed bank (secondary dispersal). Analyzing epizoochory ranking indices (www.seed-dispersal.info) of dispersed seed species revealed that transport in the fur is of minor importance for many dispersed species, i.e. epizoochory by the hooves turns out to be complementary to epizoochory in the fur. We conclude that European bison does not only function as an effective endozoochorous dispersal agent, but also disperses a considerable diversity of seed species through trampling. Further research should be based on an integrative approach to understand the long-term synergetic effect of this ecological process on to community composition and vegetation patterns in open-forest-mosaics.

O9 - HOW TO USE DOMESTIC LARGE HERBIVORES IN RESTORING WOODPASTURE LANDSCAPES ON FORMER AGRICULTURAL LAND

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Till the end of the nineteenth century woodpasture landscapes were the dominant landscape type in large parts of Europe. Now, only remnants are left of these small scaled mosaic landscapes with high conservation value. The decline was mainly due to the intensification of agricultural use. On the other hand, the abandonment of nutrient poor or poorly accessible areas resulted in spontaneous forest recovery.

Our main questions refer to the restoration of woodpasture(-like) landscapes: what processes, interacting with large herbivore grazing, enable establishment of tree seedlings and what patterns develop on former pastures and arable land? What grazing pressures and strategies should be used by managers to initiate and steer developing woodpasture landscapes? Using enclosure experiments, tree emergence experiments and survey studies in 20 grazed nature reserves in Belgium (W-Europe), we studied establishment, survival and growth patterns of tree species under different grazing regimes interacting with different structural vegetation types.

We found remarkable differences in densities, species and plant strategies in the regeneration process on former arable land and former grassland. Further, woody species regenerate below grazing pressure thresholds of 125 and 180 grazing days ha⁻¹year⁻¹ on grassland and former arable land, respectively. Lower grazing pressures allow the development of a variety of half open to closed forests within 100 years, given natural disturbances temporarily initiate tree regeneration and protective vegetation types provide safe sites for tree seedlings and saplings.

O10 - WHAT MIGHT A SUSTAINABLE POPULATION OF TREES IN WOOD-PASTURE SITES LOOK LIKE?

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Wood-pastures today are valued in the UK particularly for the species such as epiphytic lichens and saproxylic invertebrates that are associated with veteran trees. However in many sites there is a large 'generation gap', that is, there are lots of old trees, but few intermediate age trees that might replace the veterans when they eventually die. This has been identified as one of the threats to wood-pasture conservation under the UK Biodiversity Action Plan. However there is little information available as to what would constitute a sustainable population of trees. How many replacements are required and at what frequency does regeneration need to occur? What would such a stand look like?

A simple model was developed to explore the consequences of different populations structures, in terms of the numbers of younger trees that might be needed to sustain the populations of veteran trees that would still allow for continuity of conditions for veteran tree specialists. The model is based on assumptions about the maximum

age difference between successive cohorts of trees and the probability of any one tree surviving through to reach the veteran stage.

From the number of trees of different ages and their likely crown diameter two alternative landscape structures can be explored: first the degree to which the current openness of wood-pasture sites would change if the veteran tree populations were to be sustained within the current boundaries of the sites; secondly the degree to which the sites would need to be expanded if the current openness is to be maintained, but with a succession of future veterans developing close by.

Frans Vera proposed that the pre-Neolithic landscape of much of north-west Europe would have had a savannah-type structure similar to modern open wood-pastures. However this model suggests that much of the landscape would be more likely to have had a fairly closed canopy if the younger cohorts of trees, as well as sheltering scrub, are included; or that if it did have an open structure scattered old trees were not necessarily that common.

The implications of these alternatives are considered with respect to conservation policy and practice for wood-pastures in modern cultural landscapes in the UK.

O11 - THE EMERGENCE OF SEMI-OPEN LANDSCAPES FROM MULTIPLE DISTURBANCE REGIMES: A SIMULATION STUDY IN THE SWISS JURA MOUNTAINS

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Pasture-woodlands are a typical semi-open land cover type in Middle Europe, where site conditions are poor or climate is harsh and extensive grazing is the traditional land-use. Due to their structural diversity, such mixed forest-grassland ecosystems feature a variety of habitats, a rich biodiversity, including threatened species, which depend on complex landscapes. Sylvo-pastoral systems are currently considered to be a promising land-use form for managing abandoned land where natural forest development is not desirable. However a comprehensive understanding of the sensitivity of forest-grassland mosaics to the interaction of multiple disturbance regimes at several scales, such as grazing of livestock, forest gap dynamics and wind throw, is still missing.

In order to support the management of semi-open landscapes with a mechanistic understanding of the emergence of forest-grassland mosaics, we performed a simulation study with the dynamic simulation model of wood-pastures WoodPaM in the Swiss Jura mountains. We simulated tree and herb layer vegetation dynamics under realistic time series of climate and land-use in an artificial cone-shaped model landscape reaching from ~900 m a.s.l. to ~1500 m a.s.l.. After a model spin-up starting in year 0 AD, simulated extensive cattle grazing started in the natural forest in year 1100 AD, as indicated by pollen diagrams. In multiple simulation runs, we then stepwise superimposed disturbance regimes with increasing order of magnitude: extensive cattle grazing, frequent small-scale forest gap-dynamics and rare large-scale forest blowdown.

Simulation results showed a distinct impact of disturbance regimes on landscape structure and zonation of tree species. Ungrazed forest quickly regenerated towards a closed canopy and tree species zonation depended on altitude only. Grazing led to grassland and closed beech-fir-forests, both being separated from each other by a fringe of browsing-resistant spruce and maple stands. Gap-dynamics structurally diversified the tree canopy towards some glades and provided some habitat for the light-demanding maple and rowan berry, but did not disrupt tree species zonation yet. It was the interaction of grazing, gap-dynamics and windthrow, which created glades large enough to be maintained by grazers in both beech and spruce stands. From the subsequently reduced overall grazing pressure a very diverse mosaic landscape emerged with widespread presence of pioneer species such as maple and rowan berry. Fir, however, was mainly excluded from the landscape and could resist such disturbances only at the lowest altitude where climate is most favorable.

We conclude that both the structure and the species composition of semi-open landscapes are strongly influenced by succession history. Land-use and site conditions (climate) might explain currently observed landscape patterns and species distributions in a very limited way. Multi-scale disturbances have the potential to strongly and persistently influence pasture-woodlands. On disturbed sites free-ranging mega-herbivores re-direct successional pathways of forest regeneration towards a semi-open landscape.

Session F2 - Openness in temperate and Mediterranean forests

Chair: J. Buse¹

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There is strong evidence that semi-open conditions in virgin forests have been created by natural disturbances such as fire, storms, flooding, and large herbivores. In semi-natural forests grazing, selective cutting, pollarding, etc. maintained a medium level of disturbance over hundreds of years, but recent land use-changes and intensive modern forestry have led to closed canopies in forests on the one hand, and open areas used for intensive agriculture on the other hand. Increasing canopy closure in forests is considered to be a threat for biodiversity even in nature reserves. A number of habitat types and species listed in the EU habitats directive depend on open or semi-open conditions in the forest and need appropriate management. To achieve this, suggestions have been made for changes in forest management and in the management of protected areas.

The aim of the session is to present a compilation of the current knowledge on the multiple effects of openness in temperate and Mediterranean forest ecosystems. Interested participants are encouraged to contribute with baseline studies on animal communities, plant-animal interactions, vegetation dynamics, tree recruitment, and ecosystem services in the context of openness in forests or in semi-open landscapes. Contributions showing how to achieve and to manage openness in sustainable forestry and in nature conservation areas are particularly welcome.

O1 - FROM SPECIES TO MULTI-TAXA LEVEL: THE BENEFICIAL EFFECT OF CANOPY OPENNESS IN TEMPERATE WOODLANDS

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There could be seen growing evidence of importance of sparse forest structure, which may positively influence the organismal survival in recent landscapes. Some species (e.g. saproxylic beetles) formerly indicated to be relictual in primeval forests, are now abundant in more open landscape structures – like sparse pastured forests, forest edges, rural and urban avenues or even solitary trees. This is mostly not only the case of single threatened species, but often the case of beetle families (e.g. click beetles), particular taxa (e.g. *Aculeata Hymenoptera*) or guilds (e.g. saproxylic organisms). The beneficial effect of openness in landscape structure of woodland habitats can be seen also at the higher taxon level (e.g. lichens) or at the multi-taxon level (e.g. similar responses of beetles, hymenopterans and lichens).

There are many ways how to solve the problem of declining biodiversity due to canopy closure. On the other hand, many of them are so called traditional management types (e.g. pasturing and coppicing) and these are mostly not acceptable for commercial forestry. Nevertheless, there are several ways how to maintain biodiversity also in commercial woodland areas – some of them are game keeping, prolonged shelter-wood cuttings, leaving couple of trees in clear-cuts, or maintenance, promotion and planting of solitaires or avenues in the grasslands, arable land and along roads.

O2 - EFFECT OF ACTIVE CONSERVATION MANAGEMENT ON BIODIVERSITY: MULTI-TAXA SURVEY IN OAK WOODLANDS OF PODYJI NATIONAL PARK, CZECH REPUBLIC

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European woodlands used to be managed by livestock grazing, coppicing and fire that kept the forests open and favourable for fauna associated with open woodland habitats. However, these practices have been discontinued during the last two centuries in most of Europe. It has led to increased canopy closure, loss of precious habitats and subsequent decrease in biodiversity. This is also the case of oak woodlands that cover most of Podyjí (Thayatal) National Park, Czech Republic. Today, numerous endangered open woodland specialists are restricted to refugia such as forest edges or remnants of former forest steppes. As a part of a restoration management, pairs of small clearings with retention trees (each 40x40 m) have been created. Each pair consisted of one clearing connected to system of open habitats (i.e. meadows), and the other one was isolated from it by ~20m wide strip of forest, simulating thus a forest gap. We compared diversity and composition of plants, butterflies, moths, saproxylic and ground beetles, reptiles, and birds between the two types of clearings and other control habitats: closed canopy forest, forest edge, meadow, and open woodland (= forest steppe). The isolated clearings were substantially poorer than the clearings connected to open habitats. Nevertheless, in comparison to closed canopy forest, the treatment plots generally harboured richer assemblages of most taxa investigated; they also supported such emblematic species as the aesculapian snake (*Zamenis longissimus*) or the clouded apollo (*Parnassius mnemosyne*). Our results based on response of the numerous taxa demonstrate that: (i) opening forest canopy favours biodiversity, hence, it is crucial to adopt active approaches in conservation management of protected forests, and (ii) rather than creating isolated "gaps" in closed canopy forest, it is more efficient to connect newly created open canopy patches to existing open habitats.

O3 - TREE QUALITY AND CONNECTIVITY AFFECTS TROPHIC STRUCTURE OF SAPROXYLIC BEETLE ASSEMBLAGES INHABITING OLD OAKS

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Scattered tree landscapes with old oaks show a high richness of saproxylic invertebrates and are therefore of high conservation value. However, oaks in such landscapes are less connected than forest oaks which might influence trophic structure of the inhabiting invertebrate assemblage according to the trophic-rank hypothesis. While positive effects of openness on species richness of saproxylic oak invertebrates are documented, some species may suffer from isolation of oaks. The aim of this study was to analyse the trophic structure of saproxylic beetle assemblages in relation to parameters indicating different tree quality and connectivity between trees. According to the trophic-rank hypothesis we assume that high-ranked predators are stronger influenced by isolation than lower-ranked groups such as wood-feeding beetles. The study was performed in an extensively used floodplain in northern Germany using samples with flight-interception traps from 28 old oaks. We used five variables representing tree quality and calculated connectivity with six different buffer and distance measures. The analyses revealed that overall species richness and abundance is mainly determined by tree girth. Connectivity did not affect species numbers of trophic groups. Increasing isolation of oaks increased abundance of wood-feeding beetles independently of tree girth, while abundance of predatory beetles did not respond to tree connectivity. This increase was shown for common and red-listed beetles. NMDS revealed that the beetle assemblage is structured by two gradients representing tree girth and connectivity. We conclude that scattered tree landscapes support wood-feeding beetles likely because of warmer microclimatic conditions during larval development. No evidence of the trophic-rank hypothesis was found.

O4 - BIODIVERSITY OF ROVE BEETLES (STAPHYLINIDAE) ALONG GRASSLAND-FOREST TRANSECTS IN NORTH-EAST HUNGARY

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Forest edges are essential in the maintenance of biodiversity of the grassland area and the adjacent forest. According to edge effect hypothesis the biodiversity is highest in the edge than in the neighbouring areas. We

have tested the edge effect hypothesis along grassland-forest transects for rove beetle (Coleoptera: Staphylinidae) assemblages using pitfall traps and leaf litter sifter. Transects were selected in the Hajdúság Landscape Protection Area (NE Hungary). There were three habitat types on the research area: (1) a closed forest with shrubs and herbs, (2) a shrubby edge with increased ground vegetation and shrub cover, and (3) open grassland with diverse herbivorous canopy. Altogether 60 pitfall traps were placed (3 transects x 2 replicates x 10 traps). We sifted 5 litter samples from every sampling areas (3 transects x 2 replicates x 5 samples = 30 samples). Both sampling methods provided similar results. The number of individuals and the species richness were significantly lower in the grassland than in the edge and the forest. The diversity was higher in the forest edge than in the forest and open grassland. The number of specialist species changed along the grassland-forest transects. The results of the non-metric multidimensional scaling showed that the forest and the edge were separated from the open grassland. Our results suggest that the forest edge play a vital role in the maintenance of rove beetle assemblages.

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P1 - ENHANCING THE CONSERVATION STATUS OF THE PRIORITY APENNINE BEECH FORESTS HABITATS THROUGH THE CREATION OF OPEN AREAS AND GRAZING REGULATION

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The Apennine beech Natura 2000 priority habitats 9210* 9220*, i.e. beech forests where European yew (*Taxus baccata*), European holly (*Ilex aquifolium*), and silver fir (*Abies alba*) occur, are remnants of ancient, more extensive forests. Nowadays, these habitats have been extensively altered due to traditional forestry practices that transformed them into pure beech stands with continuous canopy and scarce vertical heterogeneity, with cascading effects on the diversity of several taxonomic groups.

The Life+ project (2012-2016) “FAGUS - Forests of the Apennines: Good practices to conjugate Use and Sustainability” aims at ensuring long term conservation of these priority habitats in two Italian National Parks: Cilento and Vallo di Diano, Gran Sasso Laga. Focus of the project is to test experimental harvesting practices aimed at enhancing forest heterogeneity, as a way to increase biodiversity levels and to restore the conditions that would develop under natural disturbance regime.

The concrete conservation actions include measures aimed at the long term conservation of the habitats 9210* and 9220* and were planned based on the very high complexity of temperate mixed forest systems. Indeed a great number of ecosystem components and their relationships were taken into account in order to achieve the enhancement of the conservation status of the habitat. For instance it is demonstrated that grazing may represent a threat to the renewal of the species that characterize the habitats (*Taxus baccata*, *Ilex aquifolium* and *Abies alba*), and that especially yew and holly are greatly favoured in their recruitment by exclosures. On the other hand these two species are dispersed by bird species whose occurrence and abundance is greatly influenced by open areas within forests that allow for the development of shrubs with edible fruits.

The promotion of the regeneration of the species that characterize the habitats *Taxus baccata*, *Ilex aquifolium* and *Abies alba* will be achieved also through the building of fences that prevent damage due to the presence of herbivorous in regeneration areas of the target specie where grazing is relatively intense. On the other hand the enhancement of the diversity in terms of understory will be pursued through the creation of open patches with different ecological conditions (gaps of different sizes and shape). Other actions are aimed at enhancing the diversity of saproxylic organisms and birds through the releasing of deadwood and the creation of habitat trees.

The project represents a contribution to the understanding of the role of open areas in temperate forest systems in the view of improving our knowledge of related processes such as tree species recruitment, and the enhancement of biodiversity levels.

Session AL1 - Importance of semi-natural habitats for ecosystem services in agricultural landscapes

Chairs: **M. Entling¹ & J. Schirmel¹**

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Agriculture relies on ecosystem services provided by natural and semi-natural habitats. Declining biodiversity in agricultural landscapes may result in the loss of associated ecosystem services. Both biodiversity and ecosystem services can depend on several local and landscape factors such as farming practice, agrochemical inputs, and landscape diversity.

The aim of this session is to present current research on ecosystem service relationships at different scales in agricultural landscapes. Of special interest are effects of landscape composition and diversity, farming practices (e.g. organic vs. conventional), and the role of natural and semi-natural habitats. Contributions dealing with beneficial organisms, pest species, and their relations to crop damage or yield are welcome. Research focusing on the regulating ecosystem services pollination and pest control are of special interest but there is no restriction to the type of ecosystem service.

Session AL2 - Biodiversity, structure and management of arable fields across Europe

Chairs: **E. Bergmeier¹, C. Seifert¹ & F. Goedecke¹**

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All over Europe, arable fields have undergone a drastic decline in species diversity over the past half century. In many European countries a large number of plant species of traditional agriculture is red-listed. Conservation efforts, however, though locally and temporarily effective, lack consistency and momentum at national and European levels, due to socio-economic conditions and the absence of a forceful international conservation concept for agro-ecosystems. Intensification of cropping and field abandonment have since long been identified as the most important drivers for biodiversity decline in arable systems. Presently, environmental and economic parameters favouring biofuel production seem to perpetuate and increase the pressure on alternative farming systems and the biodiversity of arable fields throughout Europe. On the other hand, during the Neolithic evolution of agriculture and its expansion up to modern times plants and animals have adapted to rather rapid change and even recent speciation could be "observed" in man-made ecosystems. Modern agriculture reflects conditions of global change and so do the species assemblages in agricultural systems.

The session attempts to set the stage for basic and applied scientists from the fields of plant and animal ecology, agriculture, and biodiversity conservation to present and discuss issues of arable diversity in fields, landscapes and countries. Focal points are diversity assessments of single or multiple organism groups, at various spatial and temporal scales, and the role of farming systems. Presentations of studies on populations, traits and phylogenies of arable plants are also encouraged, as well as talks on conservation concepts, threats, and management effects.

Session AL1 and AL2 will take place as joint session AL1/2

O1 - EFFECTS OF HABITAT ISOLATION AND HABITAT AMOUNT ON WOLF SPIDERS IN AGRICULTURAL LANDSCAPES

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Habitat fragmentation is a major threat to biodiversity. This can in turn affect ecosystem services. Wolf spiders (Family Lycosidae) are abundant generalist predators that can suppress herbivores in crop fields. We were interested in fragmentation effects on wolf spiders from an individual level including body condition and reproduction up to community level. We used pitfall traps to sample ground living spiders in landscapes that

varied independently in the level of habitat isolation and in the amount of semi-natural habitats within a radius of 500 meters. It turned out, that wolf spiders were strongly affected by habitat isolation but not by the amount of semi-natural habitats in the landscape. Interestingly, isolated grassland patches were dominated by a single wolf spider species. In contrast, many wolf spider species showed increased abundances at sites directly adjacent to forest. In addition we detected a positive relationship between abundance and body condition of male individuals of four spider species indicating that spiders adjust their habitat according to prey availability. In the most dominant spider species *Pardosa palustris* female body condition was negatively correlated with the number of eggs in the cocoon revealing a trade-off between reproduction and body reserves. Our results suggest that forest edges enhance wolf spider diversity. Due to their limited dispersal abilities, many wolf spiders are not able to colonize sites that were isolated from forest by few hundred meters. Astonishingly, the availability of connective landscape elements like hedges and single standing trees had only minor effects on wolf spider diversity.

O2 - SUSTAINABLE MANAGEMENT IN COASTAL GRASSLANDS: TRADE-OFFS BETWEEN ECOSYSTEM SERVICES

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During last decades agricultural grasslands have been used mainly for single goal, i.e. food production. However, this had partly negative effects on biodiversity and other environmental compartments such as water bodies. There is a growing concern on how to improve regulatory ecosystem services such as biodiversity, soil fertility, water and atmosphere regulation. Evaluation of different land management intensities including possible trade-offs between ecosystem services is a challenge in order to achieve a sustainable management of grasslands. Considering and evaluating regulatory ecosystem services provided by extensive and organic farming can provide added value to these agricultural areas.

With this study we evaluate different ecosystem services at plot level for grasslands of coastal regions in the North Sea and the Baltic Sea (The Netherlands, Denmark and Germany). We assess how different land uses affect the performance for different regulatory and provisional services. We found clear trade-offs between provision and regulation services which are however mediated by soil resource availability, non-consumable environmental factors such as salt, and human disturbance intensity.

O3 - NATURAL AREAS OF NORTHERN ALGERIA: AGRICULTURAL ISSUES AND ENVIRONMENTAL FUTURE

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The northern Algeria has a great wealth of natural areas. Multidimensional functions that fulfil these areas, in particular landscape feature, have not been taken into account in development policies. They are mostly a place to farming operation which creates a particular problem of degradation. On the agricultural front, these areas are characterized by low productive potential and especially by a continuous decline in the diversity of plant resources. The operating modes are the cause of this situation. They expose them to desertification that constitutes a threat to the preservation of biodiversity and the environment. In this paper we present a general reading the different situation parameters especially grasslands in semi-arid areas. We document a summary of the research conducted, particularly in terms of knowledge of operating practices, methods of restoration experienced and sketch the prospects for sustainable development of this type of space.

O4 - HOW DO DIFFERENT BIOENERGY PLANT PRODUCTION SYSTEMS AFFECT FARMLAND PHYTODIVERSITY?

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The growing interest in bioenergy production as a tool to mitigate climate change is increasing the demand for farmland to produce the necessary biomass. Bioenergy production will most likely be the main driver of land use change in Europe during the next decades. The conversion of existing species-rich, extensively managed fields and grasslands to species-poor intensively managed farmland for bioenergy production is increasingly economically advantageous. The biodiversity of historical agricultural landscapes is today among the most threatened in Europe, due to large scale land use change and the intensification of agriculture since the middle of the 20th century. Although concerns have been widely raised in the media, scientific knowledge about the possible consequences of large scale bioenergy production on farmland biodiversity is still very sparse. We would like to present results from our research project investigating the effects of different bioenergy plant production systems (biogas maize, grassland biomass and short rotation coppice) on the abiotic conditions (e.g. the light regime) and the phytodiversity of farmland in two regions of Central Germany (Southern Lower Saxony and Northern Thuringia). The patterns are considerably more complex than what is commonly suggested. We show that the consequences of different kinds of bioenergy crops on farmland phytodiversity can vary depending upon three main factors: (a) the land use practices and species pools prior to conversion to bioenergy plant production; (b) the on-site management of the bioenergy crop (which itself might depend upon the kind of generating station at which the biomass is directed), and (c) the structure of the surrounding landscape. The phytodiversity on conventionally managed farmland used for bioenergy, food or fodder production is in general extremely species poor (0 - 10 species/100 m² in the field interior). For the protection of rare farmland plant species it remains essential to conserve extensively managed farmland, without herbicide application and with only little fertilization through agri-environmental schemes.

O5 - EXPLORING STAKEHOLDERS' APPRECIATION OF CULTURAL LANDSCAPES THROUGH VISUAL PERCEPTION OF ECOSYSTEM SERVICES: THE CASE OF TRANSHUMANCE IN MEDITERRANEAN SPAIN

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Transhumance is a customary practice of mobile pastoralism, involving the regular seasonal migration of livestock herds between summer and winter pasturelands. This practice maintains unique cultural landscapes in Mediterranean Spain, which have been shaped over many centuries of pastoral activity and developed strong social-ecological systems and networks. The ecosystem services approach has been proposed as a powerful tool for the analysis of these coupled social-ecological systems. This approach is particularly useful for the evaluation of cultural landscapes, which represent the joint evolution of humans and nature across an extended time span.

Drove roads are used for herd migration, and represent the most outstanding feature of these landscapes. We used visually based landscape interpretation to evaluate social perceptions of ecosystem services provided by the last drove road in full use (Cañada Real Conquense, Spain) and the associated "transhumance landscape". Face-to-face questionnaires ($N = 314$) were given to a sample of local inhabitants, visitors, and urban inhabitants. The questionnaires contained two pairs of photographs depicting images (croplands and pine forests) associated with the transhumance landscape, with one photograph in each pair containing a drove road. We compared the social perception of 16 ecosystem services supplied by these two landscapes, and identified differences between landscapes with/without a drove road. Overall, respondents recognized the higher capacity of forests to deliver a wider range of ecosystem services to society in comparison to croplands. Provisioning services are mostly associated with cropland, whereas regulating services and cultural ecosystem services tended to be related to forests. The three types of ecosystem services were more perceived by respondents when a drove road was present in each landscape. However, differences in the visual perception of ecosystem services supply and preference towards transhumance landscapes emerged in relation to certain socio-demographic and cultural

respondent characteristics, such as a previous relationship with transhumance and agriculture, rural/urban origin and identity, environmental awareness and cultural attachment to a place. We describe four groups of respondents with consistent and diverging ecosystem services appreciation, revealing various potential conflicts and trade-offs. Finally, we discuss the applicability and usefulness of the proposed approach for evaluating ecosystem services in cultural landscapes, and toward informing policy-making processes.

P1 - POLISH RED LIST OF ARABLE WEED SPECIES - CURRENT STATE AND PROPOSED CHANGES

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It is well known that changes to agricultural practice have a large impact on the arable weed species. Over the last few dozen years the field flora, which is one of the main component of Polish landscape has become much poorer. New farming techniques, new herbicides, modern varieties of crop plants, precise cleaning of seeds brought about the disappearance of the numerous arable (segetal) weeds.

The first national schedule of endangered segetal species was prepared by A.U. Warcholinska in 1994. By now this list has become largely out-of-date. Over the last several years, the significant progress has been made in the recognition and evaluation of the threat to the arable weed flora in Poland. As a result, it proved necessary to update the list developed almost 20 years ago.

This study aims at compiling an up-to-date Polish red list of arable weed species based on the data on their distribution and threat status in individual regions. Thirteen local red lists were consulted for information concerning the threatened species as well as two national listings (Red List of Vascular Plants in Poland and List of Archaeophytes Endangered in Poland). The data were used to create a formula for calculating the new threat category for each of the species.

Comparison of the existing national list of threatened arable weed with the new list shows many differences. The list prepared by Warcholinska (1994) includes 101 taxa assigned to one of five categories (EX – 4 species, E – 11, V – 35, R – 27, I – 24). The new version of red list comprises 137 taxa, assigned to new IUCN categories currently in force: EX (6 species), CR (14), EN (20), VU (47), LR (10), DD (40). In the most cases in the new compilation the degree of threat is higher. The most highly vulnerable ones are weeds connected with flax cultivations, most of which already became extinct. A fast rate of decline has been recorded for thermophilous weeds occurring on limestone soils, as well as hygrophilous species, sensitive to mineral fertilisation.

A higher number of species with the undetermined threat category proved that there is a need to verify our knowledge about the current distribution of many field weeds to assess the real degree of its threat.

The high proportion of arable weeds classified under threat categories (over 35% of entire segetal flora) indicates that in Poland this group of species is strongly endangered. Documentation of the actual threats to segetal species of Poland, materialised as updated national red list, could be used to undertake the actions needed to provide better protection for the threatened species.

P2 - THE ROLE OF SOIL SEED BANK IN THE MANAGEMENT OF AGRICULTURAL AND GRASSLAND ECOSYSTEMS

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Biodiversity loss in agricultural and grassland ecosystems remains a challenging topic of scientific interest in the face of climate change. The need for high productivity in agriculture for food production continuously increases and becomes more complex as it should be balanced with the conservation of biodiversity and ecosystem functions. Agricultural intensification has often caused degradation of either agricultural or grassland ecosystems due to their abandonment or to impacts of changes in management and farming practices.

Conservation and restoration of the grassland ecosystems which are characterized by high plant species richness depend on their soil seed bank. Especially for the Mediterranean grasslands, they highly depend on their soil seed bank as they are composed by a large number of annual species. However, the knowledge on the role of the natural soil seed bank in the restoration and management of agricultural and grassland ecosystems remains not clear.

This review investigates the role of the soil seed bank of agricultural and grassland ecosystems for plant diversity conservation taking into consideration a) the impacts of land uses on the soil seed bank and b) the restoration measures proposed. One hundred twenty papers were reviewed covering a total time period between 1980 and 2011. Non parametric tests were applied to investigate: a) the parameters affecting the scientific interest in relation to soil seed bank and b) the detected differences related to land use, abandonment, geographical region, and ecosystem type. The potential relation between the detected impacts on plant diversity and the proposed restoration measures with regard to the soil seed bank was investigated using correlation analysis (Spearman's coefficient).

The papers emphasize on the type and site of agricultural ecosystem and their majority proposes restoration measures taking into account the soil seed bank. The type of impacts and proposed restoration are the most frequent objectives of the papers, while climatic parameters are studied less frequently. The natural soil seed bank is an important data source for the plant diversity of agricultural ecosystems, even when the impacts of agriculture are intense and the restoration potential restricted. With respect to the conservation of plant diversity, there is need to: i) further create motives to farmers, ii) consider the importance of weed seed bank and iii) plan an integrated strategy of biodiversity conservation in agricultural and their adjacent grassland ecosystems.

P3 - MEADOW TRANSFORMATIONS IN BRYNICA VALLEY (NE POLAND) IN A LAST 40 YEAR PERIOD

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Phytosociological research of meadow vegetation in Brynica valley (macroregion Chełmno-Dobrzyń Lakeland, NE Poland) was carried out in 1974-1978. The majority of examined phytocoenoses had a defined location in field maps in a scale of 1:25000 and in notes concerning respective phytosociological relevés. A possibility of repeating the vegetation research has ensued, which has been performed in last 2 years in a dozen or so selected study areas.

It was revealed that the majority of analysed phytocoenoses underwent transformations due to natural factors. The main cause of these changes is cessation of mowing which often results in other vegetation types' development due to secondary succession. Usually, development of rush vegetation of a secondary character and less often tall herbs, brushwoods and forests is observed, mainly in place of Angelico-Cirsietum oleracei and less often Caricetum acutiformis, *C. gracilis*, *C. appropinquatae*, Junco-Molinietum, Filipendulo-Geranium, Arrhenatheretum elatioris, Lolio-Cynosuretum and other phytocoenoses. Lack of mowing or its temporal limitation leads up also to less significant changes of plant communities causing only transformations of their structure and species composition. An example of this is the impoverishment of species composition of diverse plant communities of Molinietalia order or increase of nitrophilous species share in composition of some Angelico-Cirsietum oleracei and Arrhenatheretum elatioris phytocoenoses. In addition, among natural factors causing disappearance of distinct meadow transformations are also ground water level increase resulting from overgrowing of ditches and activity of *Castor fiber*.

Nearly equally frequent changes of meadow vegetation caused by anthropogenic factors were noted. Parts of very different meadow types were devastated as a result of establishment of fishpond or other water basins, building-up areas (edifices, parking lots) and afforestation (plantings of *Alnus glutinosa*). Part of meadow phytocoenoses became degraded due to eutrophication (fertilisation, vicinity of housing estates), soil drainage, grazing, meadow ploughing or grass extra sowing, yet it is rarely observed in large areas.

Research carried out revealed also the persistence of some phytocoenoses, for instance from Phragmitetea and Scheuchzerio-Caricetea nigrae classes, especially in extensively mown, forest meadows.

From analyses carried out results a fact that over a period of nearly 40 years the majority of phytocoenoses (circa 80%) has revealed smaller or bigger changes in species composition and structure, at the same time slightly

more often (over 40%) the transformations caused by natural factors were observed. Examined area is then an example of area where extensive human management or its lack overbalances the anthropopressure. It is favoured by lack of hay demand, location of the majority of meadow complexes among forests and outside big cities, as well as feeding many meadows by water seepage.

P4 - CROPLAND BIODIVERSITY IN THE WESTERN SIBERIAN GRAIN BELT

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The interdisciplinary Russian-German research project "SASCHA" aims on developing sustainable land-use strategies for the West Siberian oblast Tyumen. In this region agriculture takes place in the forest steppe ecotone, where highly fertile chernozem soils provide the foundation for large-scale grain farming. These agroecosystems are promising model systems to evaluate and predict the influence of land-use intensity and global change on cropland biodiversity. Although field sizes are large, the agriculture is characterized by comparatively low input of fertilizers and low grain yields of about 2 t/ha. First results showed that despite the low cropping intensity floral biodiversity was low and comparable with conditions known from regions with high input farming. One possible explanation for this contradiction is the short history of farming in Siberia. While in many regions arable weeds developed upon several thousand of years, the short time of coevolution since the colonization of Siberia might not have been long enough for arable weeds to adapt or migrate to Siberia. However, croplands harbored species rich grasshopper assemblages, which even reproduced on the fields. This is a remarkable result because croplands of temperate regions are not known as grasshopper habitats. Usually the disturbance through ploughing and other farming operations is so high that grasshopper cannot find suitable egg-laying sites in croplands. Our prospective research will further aim on the relation of climatic factors and land-use intensity on the described patterns and try to develop strategies to combine high diversity with high yields in agroecosystems.

P5 - FACTORS AFFECTING VEGETATION SUCCESSION ON ABANDONED ARABLE FIELDS IN A SUB- HUMID MEDITERRANEAN ENVIRONMENT

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Arable land abandonment is a major land use change in the Mediterranean region. In Greece, such abandonment is widespread in mountainous areas due to several socio-economic factors. However the rate of plant colonization and vegetation succession in these areas depend on local conditions. The aim of this study was to investigate the effects of abiotic factors on vegetation succession after abandonment of agricultural arable lands in mountain areas of northern Greece.

Seven fields were chosen in the village community of Taxiarchis in north Greece, (mean altitude 850 m) characterized by subhumid Mediterranean climate, each reflecting a different period of abandonment of agricultural use, following a time series of ten years (abandonment age 1, 10, 20, 30, 40, 50 and 60 years each approximately). In each of the seven fields plant species composition, flora and abiotic data (time, elevation, slope, texture, pH and soil nutrients organic C, N, C:N ratio, P and the Ca, Mg, K) were measured. Overall, 167 species belonging to 37 families were identified in the studies plots and classified into functional groups (grasses, legumes, broadleaf herbs, woody species and *Pteridium aquilinum*). Based on species composition we used the cluster analysis to classify the degree of similarity each of the communities of seven fields. The ordination analysis revealed four clearly interpretable vegetation groups. The two first consisted of field aged 1, 10 and 20 years, the third included fields aged 30, 40 and 60 years and the fourth the union of third group with field aged 50. The major change on species composition observed at 30 years, mainly attributed to the dominance of perennial grass *Agrostis canina*.

Moreover, the relationships between the composition of vegetation and abiotic factors were analyzed using Detrended Correspondence Analysis (DCA). The results demonstrate that there is a strong interaction between

vegetation and abiotic factors. In order to find which of abiotic factors affecting of vegetation composition, the Canonical Correspondence Analysis (CCA) were also used. The analysis showed that time since abandonment was the key factor for the evolution of vegetation and the first CCA axis depicted a time gradient. Elevation, soil texture and slope were also important in vegetation succession on abandoned arable fields in Taxiarhis region.

P6 - EXTENSIVE UTILISATION OF MEADOWS – TO MAINTAIN HIGH NATURAL VALUES IN AGRICULTURAL LANDSCAPE

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Agricultural landscape constituting a compensation of natural and anthropogenic processes currently undergoes strong transformations due, primarily, to farming intensification. They contribute to increasing hazards of semi-natural phytocoenoses as expressed by the simplification of the landscape structure through disappearance of biotope islands and ecological connecting links and the removal of marginal sites in favour of uniform, large-area meadows, pastures and arable land. However, extensive valleys still constitute areas of considerable natural mosaic character of sites as reflected by varying richness of plant cover and landscape which depends on utilisation intensity.

The objective of the performed studies was to assess the impact of extensive one-cut utilisation of selected meadow areas on the maintenance of species richness, increasing floristic diversity and value improvement of lowland landscape. For this purpose, in years 2008-2012, one thousand phytosociological relevés were collected from meadows situated in the Odra River valley in the region of the Great Odra Wetland using the classical Braun-Blanquet method. From the above number of phytosociological relevés, 60 were selected taken from areas where extensive meadow management was conducted (one cut in August) and the following parameters were determined: species composition of the examined phytocoenoses, their naturalness expressed by the degree of synanthropisation and hemeroby as well as the occurrence of protected and endangered species in the region of Wielkopolska. In addition, species dynamism (Zarzycki et al., 2002) as well as natural value of phytocoenoses (Oświt 2000) were determined.

The floristic composition of the examined meadow communities was dominated (90% of the surface share) by species characteristic for *Molinio-Arrhenatheretea* and *Phragmitetea* classes. The following other species, which were not found to occur in the neighbouring areas utilised more intensively (i.e. cut 2 or 3 times during the season or grazed at the stocking rate of 2 to 3 large animals per ha) or not utilised at all, were recorded among them: *Molinia caerulea*, *Briza media*, *Dactylohriza incarnata*, *Cnidium dubium*, *Sanguisorba officinalis*, *Linum catharticum*. At the same time, areas cut once were characterised by a small proportion of synanthropic species which affected their moderately high and high natural value. It can be concluded on the basis of the performed investigation that extensive (i.e. single-cut) utilisation even of small meadow areas makes it possible to maintain lowland landscape diversity.

P7 - IMPACTS OF LAND-USE INTENSITY ON SOIL STRUCTURE AND FUNCTIONS IN A CENTRAL SPAIN OPEN LANDSCAPE LINKED TO TRANSHUMANT PASTORALISM

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Transhumance is a customary practice of mobile pastoralism, involving the regular seasonal migration of livestock herds between summer and winter pasturelands. This practice maintains unique cultural landscapes in Mediterranean Spain, which have been shaped over many centuries of pastoral activity and developed strong social-ecological systems and networks. The ecosystem services approach has been proposed as a powerful tool for the analysis of these coupled social-ecological systems. This approach is particularly useful for the evaluation of cultural landscapes, which represent the joint evolution of humans and nature across an extended time span. Livestock routes are used for herd migration, and represent the most outstanding feature of these landscapes.

The impact of land-use intensity is evaluated through changes in the soil properties in different areas of the traditional central Spanish landscape, including the topsoil of active and abandoned vineyards, livestock routes and young *Quercus* afforested areas. Soil organic carbon (SOC) content, bulk density, aggregate stability and water-holding capacity (WHC) were analyzed. These different types of land use can be interpreted as having a gradient of progressively less impact on soil functions or conservation. As soil use intensity declines, there is an increase in SOC content (from 0.2 to 0.6%), WHC (from 0.2 to 0.3 g H₂O per g soil) and aggregate stability (from 4 to 33 drop impacts). Soils beneath vines have lost their upper horizon (15 cm depth) because of centuries-old tillage management of vineyards. Except for an increase in bulk density (from 1.2 to 1.4 g/cm³), there were no differences in soil characteristics 4 years after the abandonment of vine management.

Livestock Routes can be considered sustainable uses of land, which preserve or improve soil characteristics, as there were no significant differences between topsoil from LR and that from a 40-yr-old *Quercus* afforested area. SOC content, one of the main indicators for soil conservation, is considered very low in every case analyzed, even in the more conservative uses of land. These data can be useful in understanding the slow rate of recovery of soils, even after long-term cessation of agricultural land use.

P8 - COLLAPSE OF LAND RECLAMATION SYSTEM AS A MAIN DRIVER OF RIPARIAN VEGETATION DIVERSIFICATION IN AGRICULTURE LANDSCAPE

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Vegetation adjacent to watercourses is an important component of the agricultural landscape due to its influence on water quality, biodiversity, landscape permeability, as well as aesthetic values. The riparian vegetation is also the most frequent semi-natural habitat in agricultural areas of Europe. In the eastern part of Central Europe, in former communist countries, the agricultural landscape of open fields differs from the one in western Europe due to the creation of 'collective' farms since 1945. Recently, the areas still suffer from the problems of socio-economic transformation, including the widespread effects of collapsing land reclamation systems. The structure and potential of riparian vegetation for maintaining biodiversity, as well as effect of socio-economic transformation in this areas is poorly known. We present here the results of our study of vegetation adjacent to watercourses in the lowland agricultural landscape Odra river valley (Poland, Central Europe). The study was undertaken on three sites that differ in respect to their drainage ditch management and dominant land use form. The watercourses were divided into homogenous sections with respect to vegetation, channel morphology and water regime. The coverage of dominant plant species (>5% coverage) in vegetation along the watercourse was visually assessed. A total of 134 km of watercourses were studied. In the banks and margins of the watercourses we recorded 161 species of vascular plants. The riparian vegetation could be divided into 9 types which differed in species composition and vegetation structure. Four of them, dominated by grasses, could be connected with the management of ditches, whereas remaining types, consisted of woody plants or common reed (*Phragmites australis*) were related with ditch management cessation. The riparian vegetation dominated by species as *Phalaris arundinacea*, *Deschampsia cespitosa* and *Cirsium arvense* was able to harbor many plant species that occur on extensively used meadows and pastures, the most rapidly disappearing habitats in Poland. The cessation leads to widespread of typical forest plants species along watercourses into the areas of open fields, while the species typical for open habitats avoid forest neighborhood. The influence of different kind of agricultural usage (arable land, grassland, fallow land) was less important than the general difference between watercourses place next to forests and those in the open surrounding. The ditches morphology, as well as the presence of water influenced the species composition significantly, nevertheless they were not crucial factors influencing the surveyed vegetation. Results emphasize the need of mowing or grazing for most favorable vegetation types preservation, in terms of both biodiversity and land reclamation system maintenance.

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City centre

The City centre of Hildesheim is about 15 minutes away from the Conference venue by public transportation (see city map, (see public transportation)).

Cloak room

It is possible to store your luggage in room H 010.

Conference venue

The conference will take place at the main campus of the University of Hildesheim, Marienburger Platz 22 (see map).

Conference office

You will find help and information at the Conference office in room H 010.

Computer room

You can check your presentation or use the internet at the computer room D 108.

Internet access

You can use wireless Internet by Eduroam or with a voucher from the University. You can get a voucher at the Conference office. We also provide some computers in room D 108.

Lunch

You can have lunch at the Mensa (see map). At the Mensa special meals will be provided for the Open Landscapes Conference. For these meals you need a voucher which you can buy at the Conference office or registration desk. The Mensa will also serve other meals. **Please note that the voucher is ONLY for the special conference meals and cannot be used for any other meal.** You can also have lunch at the “Café Campus” (see map) or directly in front of the University where you can find an Italian and a German Restaurant.

Map

A map of the University is provided on page 3.

Oral presentations

For each oral presentation, there will be a 20 minute time slot (15 minutes for the presentation and 5 minutes for discussion). Please make sure that your presentation stays within this time frame to allow all participants to change between sessions.

Each conference room will be equipped with a beamer and a computer running with Windows and MS Office 2010. It will not be possible to use your own computer. There will be no Macintosh or Linux based computers. Please make sure that your presentation can run under Windows

Please provide your presentation either as PowerPoint or PDF File. Overhead or slide projection will not be available. It will be possible to check the presentation on correct functioning and display of all slides in a computer room (D 108). **Please hand over your presentation to the session chairs of your session at least 10 minutes prior to the session start.** It will be also possible to upload your talk during the conference breaks in your conference room.

Parking

There are several parking lots at the main Campus of the University (see map).

Poster Session

The poster session will take place on Wednesday. We kindly ask you to put up your poster as early as possible while all **posters should be on display for the whole conference!** On Wednesday, all posters should be removed after the poster session and not later than 8 pm. Remaining posters will be disposed after the conference.

Authors are expected to attend their poster during the whole poster session. Posters will be allocated to the specific sessions and will have an individual ID number. We will serve some drinks and snacks during the Poster Session (on your own cost).

Public transportation

From the City centre take bus number 4, direction "Itzum" and get off at "Universität". From the train station take bus number 3 "Marienburger Höhe/Itzum" and get off at "Universität". From the Conference Venue take bus number 3, direction "Hauptbahnhof/Hildesheimer Wald" to the Central station (Hauptbahnhof) and bus number 4 (104 in the evening), direction "Im Koken-Hof/Bockfeld" to the City centre (get off at "Schuhstrasse").

Registration

Registration will be possible during the whole conference. On Sunday, registration opens at 5 pm. On Monday, registration opens at 8 am. On Wednesday registration will close at 12 pm.

Taxi

Taxi numbers for Hildesheim: 0176-62008658, 0176-12242424, 05121-1779249.

Tourist Information

You can find the Tourist information at the historical market place (see map).

Notes



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