IAVS 2013

56th IAVS SYMPOSIUM

VEGETATION PATTERNS & THEIR UNDERLYING PROCESSES

ABSTRACTS

26–30 JUNE 2013 TARTU ESTONIA

56th Symposium of the International Association for Vegetation Science

Vegetation Patterns and their Underlying Processes

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26–30 June 2013 Tartu Estonia

Organised by:

Department of Botany, Institute of Ecology and Earth Sciences, University of Tartu

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Welcome message

It is our great honour and pleasure to host the 56th Symposium of the International Association for Vegetation Science (IAVS 2013) in Tartu, Estonia, 26–30 June 2013.

The International Association for Vegetation Science is a bona fide scientific society supporting research in the field of vegetation science, a principal discipline in Ecology. The IAVS is a very active scientific body, typically organising one (and occasionally two) annual general meetings. This is the first time that the IAVS annual symposium takes place in Estonia.

The main theme of IAVS 2013 is "Vegetation patterns and their underlying processes", although topics on all aspects of vegetation science are welcome. Sessions aim to address innovative theory, methodology and application of vegetation ecology over a range of spatial and temporal scales. Particular focus is on processes and drivers behind vegetation diversity and dynamics, both in natural and anthropogenic landscapes. The presentations address patterns and processes concerning natural undisturbed vegetation, as well as under conditions of changing anthropogenic impact. The abstracts represent scientific results obtained by traditional descriptive and experimental approaches to vegetation science, as well by modelling or contemporary molecular methods.

Altogether 451 participants from 41 countries are taking part of the Symposium. This abstract book contains 182 oral and 192 poster presentations representing all participating countries.

I anticipate that all participants will enjoy the interesting scientific program of the 56th Symposium of the International Association for Vegetation Science in Tartu!

Martin Zobel
Chairman of the organising committee

Poster D114

Light- and nitrogen-use and aboveground biomass allocation along productivity gradients in grasslands

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Light and nitrogen availability are two of the factors limiting plant growth in natural communities most frequently. Plants have to compromise between effective light-use, nitrogen-use and biomass allocation to better accomplish one of those resource uses. We examined following questions: 1) How do light- and nitrogen-use change along productivity gradients in structurally contrasting herbal stands, both at community level and in more abundant species? 2) Is a decrease in leaf area ratio (LAR) the universal response to increasing aboveground biomass in herbaceous communities? More specifically, is specific leaf area (SLA) or leaf mass fraction (LMF) responsible for the change in LAR? Two study areas were located in natural grasslands at Laelatu and one site at Aru in Estonia. In Laelatu, patterns of light- and nitrogen-use were assessed along two productivity gradients in wet (W; 8 0.5×0.5 m sample plots) and dry (D; 10 plots) herbaceous communities. In Aru 10 plots were distributed in an old grassland. Leaf area index (LAI), LAR, SLA, LMF, light acquisition efficiency (Φ_M), light absorption per unit of leaf nitrogen (Φ_N), aboveground nitrogen-use efficiency (aNUE), leaf nitrogen content per unit leaf area (N_A) and parameter of competition asymmetry (B) were calculated for more abundant species. Aboveground biomass (M) gradient in W site ranged from 341 to 503 g m^{-2}, in D site from 248 to 682 g m^{-2}, in Aru from 150 to 490 g m^{-2}. A decrease in LAR is not a universal response to increasing M. While LAR decreased in two grassland communities with increasing site productivity, it unexpectedly increased in one site with a rise of productivity. In a high-LAR community, adjustment of leaf morphology via change in specific leaf area (SLA) is responsible for an increase in LAR with rising productivity. In low-LAR stands, rather a modulation of both leaf mass fraction (LMF) and SLA is responsible for diminishing LAR with rising productivity. In a low-LAR community (Aru), Φ_M declined at the community level and also in most species. Whereas on the basis of two other grasslands (one low-LAR and one high-LAR), the hypothesis may be established that an optimum of Φ_M exists along a productivity gradient independent of herbaceous community type. A trade-off was established between N_A and LAR in two herbaceous communities.

Poster D115

Morphological plasticity to species identity of neighbours depends on the frequency of encountering conspecific and heterospecific neighbours

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Morphological plasticity is the ability of plants to change phenotype depending on environmental variation. Plasticity varies among species, and its evolution is conditional on multiple factors: i) fluctuation of the environment is needed; ii) variation in the environment should be detectable via reliable cues and early enough to allow a timely response; and iii) different environments should be common and occur at more or less similar frequencies. Plasticity to variation in abiotic conditions has been well studied, but little is known about reactions of plants to biotic environments. We used conspecific and common heterospecific neighbours as two biotic environments and tried to confirm theoretical predictions concerning the evolution of plasticity. Twenty-eight focal species from seven seminatural grassland communities were chosen and the probability of encountering different neighbours in the field was determined for each focal species using nearest neighbour analysis. Focal species were grown in a pot experiment with conspecifics and a common heterospecific neighbour. Six aboveground morphological traits were used to assess plasticity. The results showed that the degree of plasticity to neighbour identity varied among species and that different species exhibited plasticity in a different number and combination of traits. Greatest plasticity to neighbour identity was found in species for which both neighbour types (conspecific and heterospecific) were common and encountered at similar frequencies in the field. Plasticity was low if one of the neighbour types was encountered in the field at a low frequency while the other neighbour type predominated.

Poster E164

Populations dynamics in sizes of wild *Melissa officinalis* L. *(Lamiaceae)* for the last decade in the Republic of Armenia

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Armenia has a rich flora of ca. 3600 plant species (ca. 50% of the entire Caucasian flora), distributed across (semi) desert, steppe, forest and alpine landscapes. Native plant biodiversity and conservation status of these species, particularly those with economic value, needs further assessment 1. Only limited information, however, on population ecology and conservation status of these species is available. Anthropogenic threats to this biodiversity such as overpopulation, deforestation and urbanization have simultaneously hindered research and increased the need for it.

During three consecutive years (2007-2009) , field studies and eco -geographic surveys in respect with Maxted (1995) methodology were conducted to examine *M. officinalis* L. populations' ecology e.g. habitat characteristics, populations sizes and its dynamics, certain abiotic environmental factors and biotic interactions among species that might affect on changes in sizes etc. Quadrate sampling technique has been identified as the key element for determining of populations sizes and abundance. In fact, the conducted observations exposed that populations either expanding or dwindling in their sizes in different regions of Armenia. Mostly, populations growing in central (Orgov, Garni) and North (Ayrum) regions of the country are depleting in their sizes. On the other hand, populations growing in South and South-East regions of Armenia are expanding in their overall sizes (e.g. Srashen, Jermuk). Some anthropogenic threats that were identified as part of the study included poor land management (erosion, overgrazing), increasing population pressure (impact of livestock overpopulation, improper human development), and excessive or inappropriate collection for the purposes of local sale/usage (due to lack of knowledge/training of collectors).

This research provided baseline data that can be used for the development of further conservation strategies of these unique genotypes, as well as to assess the vulnerability of wild populations with regard to the IUCN Red Book Criteria, of this important medicinal and culinary species in Armenia.

References: 1. IUCN, WHO, WWF (1993). Guidelines on the Conservation of Medicinal Plants, IUCN, Gland, Switzerland, 50 p.; 2. Maxted N, van Slageren MW, Rihan JR, Ecogeographic surveys. In: Guarino L, Ramanatha Rao V, Reid R (eds.) Collecting Plant Genetic Diversity Technical guidelines. CAB International, Wallingford International Plant Genetic Resources Institute, Rome, Italy, (1995), Chapter 14, pp 255-287; 3. National Report on the State of Plant Genetic Resources in Armenia, Ministry of Agriculture of The Republic of Armenia, Yerevan, 2008, p. 49

Poster A1

Dispersal and spatial distribution of early ecotype of hemiparasitic *Melampyrum nemorosum*

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Hemiparasitic plants of grasslands are becoming rare in the modern landscape. This trend is usually explained by changes in management, intensification of agriculture and fragmentation of habitats. We focused on the early ecotype of *Melampyrum nemorosum* which is a rare grassland hemiparasite. In the Czech Republic, it nowadays occurs only in species-rich meadows of the White Carpathian region. By contrast, the late ecotype of the species is common on the egdes of broad-leaved forests and bushes.

Our aim was to describe the spatial pattern of the early ecotype of *Melampyrum nemorosum* in the community and mechanisms underlying it. We considered dispersal and habitat limitations which also involved testing for presence of suitable host species. For testing it, we established a four year seed-sowing experiment on previously unoccupied sites, which also provided an insight into the effect of the hemiparasite on the community. Host spectra were analysed by dissecting of roots followed by DNA-barcoding of roots to which haustoria were attached coupled with anatomical observations of the attachments. The spatial patterns were analysed on the landscape scale. We mapped the early ecotype on four localities and described the patchiness using spatial statistics. We also tested the aggregation of the hemiparasite with solitary oak-trees and bushes presumably proving suitable conditions for its growth.

Sowing experiment showed strong dispersal limitation and significant effect on community. For the early ecotype we identified certainly 6 host-plants. The rest of samples of attacked species couldn't be verified by anotomical observation. We also identified one species able to successfully defend to *M. nemorosum* haustoria. For the late ecotype we identified 4 attacked species but 2 can with certainty serve as hosts. Host spectra for both ecotypes differed strongly. Interesting finding was also that sowing of early ecotype didn't significantly affected abundance of identified hosts in the community. Spatial statistics revealed aggregation of hemiparasite around oaks and bushes only on one of mapped localities, on the rest three of sites it grew far from this vegetation and preferred rather open meadow space.

It seems that weak virulence of the early ecotype with combination with strong dispersal limitation could be life-strategy, how to facilitate the next generation to persist on site. Over-using of host resources could lead to the situation when descendants which do not spread far wouldn't have what to parasitize.

Effects of dam-regulated flows and fragmentation in species and trait composition of streamside forests

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Riparian or streamside forests are key-components of river systems generally adapted to natural flow dynamics and disturbance regimes. Changes in the natural flows and fragmentation of riparian corridors by river regulation interfere in the ecological processes of riparian zones and may induce compositional shifts in species and functional traits of riparian plant communities.

The objective of this study is to assess the ecological responses of riparian vegetation caused by river damming in Portugal. Since dams are constructed for diverse purposes (irrigation, hydropower generation, water supply) and have differences in net storage capacity, years after regulation, mean annual flows and capacity of regulation, we intend to understand the impact of these features in vegetation. The biogeographical variation of riparian forests was taken into account. We selected 20 rivers regulated for different purposes and located in different river types -Mountainous, North, South, and Transition North-South. Floristic surveys were done downstream from dams, i.e. at "regulated" sites (REG), and at upstream reaches with no significant stressors, i.e. "natural" sites (NAT). Twelve plant functional traits related with growth, productivity and reproduction were selected as expressions of key-vegetation processes and population dynamics related to flow components. We used normalized species abundances and Bray-Curtis (BC) dissimilarity to make a paired comparison between NAT and REG sites. Then, we conducted a Permutational multivariate analyses of variance with R-vegan function Adonis to test the responses to regulation and the differences between river types. Other analyses are in course as well as the enlargement of the database.

In average, rivers regulated for hydroelectric production displayed a higher BC NAT/REG distance than rivers regulated for water supply and irrigation. No significant relationships were observed between years of regulation, dam net storage capacity and riparian species and trait composition. However, we found significant positive correlations between the capacity of regulation (storage capacity/mean annual flows) and the NAT/REG distance. Mountainous and Transition rivers have higher NAT/REG distance when compared to South rivers, and differences between NAT and REG sites from different river types were significant. BC distances were lower among NAT and among REG than the NAT/REG distances, which was consistent with our expectations. This study provided evidence that damming induce changes in different streamside forests which appears to be related with water deficits and flow variability caused by regulation.

A graph-based approach to assess the effect of biased sampling effort in species' niche models

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The delineation of species' niches and distributions are typically based on known occurrence records derived from collections in natural history museums, herbariums and biological surveys. Quite commonly, records within these data sources are affected by geographical and environmental bias, and may therefore give fuzzy indications to species distribution models.

Given a set of species occurrence records R, we define a graph G where vertices represent occurrences, and where two vertices are linked if the corresponding two records are considered to be biased. Two records may be considered biased if, for instance, the two sites are environmentally very similar, or if, in addition, they are geographically very close. We call G the biased graph of dataset R. A subset of records from R is unbiased if no pair of the corresponding vertices are linked. In graph theory subsets of vertices with no links are called independent sets. Finding a maximum independent set is a classical (and difficult) problem in graph theory.

In this study we aim to compare the effects of using different equally-sized subsets of species occurrences with varying levels of bias on the accuracy of niche modelling. We start by determining the maximum independent set I of the biased graph G associated with a set of species occurrence records R, and generate several random subsamples of R with the same size as I. For each sample we calculate what we call the bias index, which is 1 minus the ratio between the maximum size of an independent set in the subgraph of G, whose vertices correspond to occurrences of the sample, and the size of I. The independent set I has bias index of 0, and bias indices close to 1 indicate samples with very large bias. We are presently envisaging consistent methodologies to relate bias indices with modelling accuracy, and we trust to have soon conclusive responses for the effect of bias sampling effort in species niche models.

How do plants coexist in species rich communities: ecohydrological processes and drivers

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Ecologists still puzzle over how plant species manage to coexist with one another while competing for the same essential resources (light, CO_2, water, nutrients and space for growth). One possible explanation is the existence of niches, in which plants realise their relative competitive advantage over others. Through appropriate quantification of relevant niches, some niche mechanisms have already been identified. One of the most striking niche axes for plants is that of hydrology (e.g. Silvertown et al. 1999; Araya et al. 2011). Water availability is key for plant growth, not only as a direct resource but also as a resource gradient, with implications on soil aeration, soil physical properties, microbial processes and nutrient mineralisation (Araya et al. 2012).

Synthesis of eco hydrological niche segregation studies undertaken, across a wide range of water regimes in different ecosystems: from the flood-plain meadows of temperate UK, to the Mediterranean Dehesa grasslands of Spain, to the Southern African fire-dependent fynbos is presented. Investigations were undertaken at varying scales and levels of variable control (i.e. field, laboratory, mesocosm) as well as on associated soil biological and chemical properties. Niches were quantified using transferrable site-independent parameters; while plant physiological response was investigated via stable isotope proxy. Where relevant, phylogenetic differences were accounted with independent contrasts. Results emphasise the salient role of hydrology in niche segregation and evolution. The relevance of eco-hydrological processes towards understanding and targeted conservation of plant communities is demonstrated with examples of successful practical conservation experience. Scenario prediction on future plant distribution in response to changing hydrological conditions is also discussed.

Key Work References: Silvertown et al. (1999) Nature 400: 61-63 ; Araya et. al. (2011) New Phytologist 189 :253-258 ; Araya (2012) Journal of Vegetation Science DOI: 10.1111/j.1654-1103.2012.01481.x

Habitat loss and plant richness in south Brazilian grasslands: Has extinction debt been already paid?

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Land use conversion of native grassland into cropland in southern Brazil mostly started in the 1970's and most of today's grasslands still exist due to traditional management with livestock. Here we evaluate the response of plant richness to landscape and management drivers and examine if there is evidence of extinction debt in plant species.

We selected 26 grassland fragments larger than 5 ha in a region of 8000 km² in south Brazil. In each fragment, we identified plant species in nine 1m² quadrats within a fixed sampling unit of 1ha. Interviewing the farmers, we recorded information on management variables: mowing, manual weeding, and herbicide use. We attributed values to the answers and management intensification was taken as the sum of these variables. We analyzed satellite images of the sampled areas from 1981 (beginning of conversion into agriculture) and 2009 (recent land use). For each image, we calculated the percentage of grassland cover in a circle with a radius of 2 and 8 km from the sampling unit and the current size of the fragments. We performed linear models to analyze the effects of landscape and management drivers on plant species richness.

The results indicated that species richness was linked only to percentage of grassland cover on 2009 within a 2 km radius (R^2=0.15; p=0.042) but not within an 8 km radius (p=0.49), nor to the variables of 1981 (2 km: p=0.32; 8 km: p=0.63). Also, there was no effect of current fragment size (p=0.27) or management variables (intensity: p=0.84; herbicides: p=0.98; weeding: p=0.31; mowing: p=0.98). There was no correlation between management intensity and fragment size (r=-0.14; p=0.49), percentage of grassland cover in 1981 (2 km: r=-0.04; p=0.83; 8 km: r=-0.10; p=0.62) or in 2009 (2 km: r=-0.12; p=0.55; 8 km: r=-0.15; p=0.46). Our results indicate that there is not extinction debt in plant species in this grassland ecosystems, which means the response of plants to habitat loss is very fast and depends on the immediate neighbourhood (2 km radius) of recent land cover, more than the actual size of the fragment, the regional landscape (8 km radius) and the land use of three decades ago, when habitat loss began.

Poster E165

Impacts of land use changes on the vegetation of Mediterranean drove roads

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The Iberian Peninsula is one of the last regions in Europe where transhumance is still practiced by some pastoralists, moving livestock along corridors up to 75 m wide termed drove roads. In Spain, almost 1%of the territory is covered by drove roads, which constitute a key component of traditional Mediterranean landscapes. Vegetation in well-preserved drove roads is shaped by seasonal livestock grazing, and they act as true reservoirs of plant biodiversity in landscapes with a low presence of large herbivores. However, the current trend towards grazing intensification is triggering the abandonment of many drove roads and the emergence of new aggressive uses, very often accompanied by uncontrolled traffic of motor vehicles producing strong soil disturbance. Here, we analyse the impact of these two factors on the vegetation of the drove roads. For that purpose, we selected 22 drove road stretches, showing a range of uncorrelated pastoral use and soil disturbance intensities. In each stretch we sampled vegetation, using 25 quadrats of 20 × 20 cm. Results show that grazing abandonment causes a profound change in species composition, although species richness remains unaffected. Functional trait spectra are also affected, with a significant reduction of prostrate and short sized species, rosettes, hemicryptophytes, and small seeded species. Plant communities in abandoned drove roads are also less original, and include more ruderal species. On the other hand, soil disturbance leads to a reduction in species richness, but does not significantly change community composition. That is, disturbed drove roads are an impoverished version of well-preserved drove roads if traditional seasonal grazing persists, while drove roads simultaneously affected by grazing abandonment and soil disturbance tend to vulgarize their species composition and strongly reduce species richness. On the light of our results, we strongly recommend the restoration of traditional use in drove roads in order to preserve their positive roles on plant biodiversity on the landscape scale. Where this is unfeasible, management measures able to produce effects similar to traditional extensive grazing could be implemented.

Habitat quality and present and past landscape effects on plant species composition similarity

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During the last century, semi-natural pastures and grasslands showed a general decline and forest encroachment in Europe and particularly in the Mediterranean basin. As a result, species extinctions and colonisations are taking place and a substitution of grassland specialists by generalists and forest species is expected in these habitats. Nevertheless, these changes may occur long time after habitat reduction and forest encroachment, thus determining extinction debts and immigration credits affecting present species composition.

The study was conducted in a heterogeneous mosaic of Mediterranean grasslands and open forests in Prades Mountains (NE Iberian Peninsula), over an area of 15 × 13 km. Because of the lack of clear boundaries between habitats, a continuum approximation was used to study plant species composition in these Mediterranean grasslands, selecting a set of sites within a landscape gradient of grassland loss and forest encroachment in the last 50 years.

Our aims were i) to disentangle the contributions of local habitat quality and landscape to plant species composition (total species and grassland specialists), and ii) to evaluate whether a trace of past landscape was still influencing present species composition in this landscape gradient. A total of 20 sites of 100 m radius representing a range in past (1950s) grassland and grassland reduction were selected. At each site, 13 vascular plant surveys were made in regularly distributed plots of 3 m diameter. Measures of local habitat quality (soil, grazing and light availability) were made at each plot, and past and present open-habitat in the landscape was calculated using GIS. Mantel and partial Mantel tests were used to explore the association of differences in species composition (β-diversity) with habitat quality and landscape distances in sites.

We found a significant β-diversity correlation with both habitat quality and landscape composition when taking into account all species, specialists or generalists. Past grassland amount differences in the landscape were significantly and positively correlated with β-diversity when considering grassland specialists and also all species (even when removing the effect of habitat quality and present landscape), but not when only generalist plants were considered.

These results suggest that both surrounding landscape and local habitat quality influence species composition in a context of land-use change and loss of traditional Mediterranean mosaic landscape. Even 50 years after major landscape changes started, a significant effect of past landscape remains in plant specialist composition.

The ABC of model evaluation: a visual method for a clearer assessment of model accuracy

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Models that predict species' distributions or ecological niches, based on inferred relationships between species occurrence and environmental variables, need to be evaluated for their quality or predictive capacity. However, commonly used model evaluation measures, such as the area under the receiver operating characteristic curve (AUC), correct classification rates (including sensitivity and specificity), Cohen's kappa, and the true skill statistic, are known to be strongly affected by the species' prevalence or extent of occurrence in the study area: widespread species yield apparently poorer models than species with restricted distributions. Nevertheless, models for widespread species may actually be quite accurate and correlate with independent measures such as species abundance. The problem lies in that these evaluation measures assess only the discrimination capacity of models: they start by converting continuous model predictions into an overly simple binary output (or a series of possible binary outputs, in the case of the AUC), and then evaluate the performance of these binary outputs instead of what the models really predict. We argue that, when the modelling aim does not require binary predictions, discrimination measures should be replaced (or at least complemented) with calibration or reliability measures applied directly to the continuous predictions. We propose a new model evaluation method, the Area Between the Curves (ABC), which can be applied to presence probability models and provides, besides various quantitative metrics, a visually explicit plot showing how much, in which direction and where in the explanatory and predictor space each model departs from observed distribution patterns. It also includes several methods to divide the predicted probability values into bins that allow meaningful comparisons between observations and predictions. We illustrate this procedure on a set of generalised linear models built for European tree distributions (http://www.euforgen.org/distribution_maps.html) gridded on UTM 50×50 km cells, including restricted to widespread species (prevalences ranging from 0.4% to 73%). We show that, unlike common evaluation measures based on discrimination ability, the ABC is not conditioned by species prevalence and, together with its associated plot, gives a clearer and more informative picture of the accuracy and weaknesses of model predictions. We also illustrate the advantages of the ABC over previously existing (albeit underused) measures of model reliability, such as the Hosmer-Lemeshow goodness-of-fit test and Miller's (Cox's) calibration statistics.

Species preference for different forms of nitrogen along a soil reaction gradient: how does it correlate with the habitat niche?

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Background Dominance and occurrence of plant species change distinctly along soil reaction gradients, which has been attributed to different chemical factors varying with soil pH, such as concentrations of toxic compounds or nutrients. The availability of different chemical forms of nitrogen (N) is thought to be one of these factors, but the extent to which this can explain species distribution is yet unclear.

Methods We carried out a common garden experiment and a greenhouse experiment using species from Central European sandy grasslands. Availability of ammonium and nitrate was manipulated in the presence and absence of interspecific competition, and growth responses were used to calculate species preferences for certain N-forms.

Results Species habitat niches, represented by their Ellenberg Indicator Value for soil reaction, were found to strongly correlate with species preferences for certain N-forms, with acidophilous species preferring ammonium and calciphilous species preferring nitrate. This was the case in all experiments and treatments without species interaction, but surprisingly not for species mixture treatments, that might have involved additional soil biota with impact on N-cycling.

Conclusion High importance has to be attributed to species' preferences for certain N-forms, because these impact on species occurrence along soil reaction gradients. Considering the known importance of other restrictions like aluminium toxicity or iron nutrition, it is likely that these factors act in concert with species' N-form preference. Our finding that species interaction impacts on such interrelations in an unexpected manner poses the future challenge to devise multi-factorial experiments on species occurrence along soil reaction gradients.

Percolation networks of dominant grasses drive diversity and assembly of subordinates in semiarid sand steppes

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Questions: How dominant species control or regulate diversity of subordinate species in semiarid sand steppe? Do landuse and climate changes affect subordinate species directly or these effects are mediated by the changing patterns of dominant species?

Location: Open perennial sand steppes at two sites, Csévharaszt (47°17'N, 19°24'E) and Fülöpháza (46°53'N, 19°23'E) situated along an aridity gradient in the Kiskunság area of Hungary.

Methods: Four stands of sand steppes (dominant species are: *Festuca vaginata* and *Stipa borysthenica)* were monitored since 1996. For monitoring we used a standard sampling design - a version of the line-intercept sampling - where presence of plant species are recorded along 52 m long circular belt transects of 1040 units of 5×5 cm contiguous microquadrats. Fine-scale diversity and assembly rules were evaluated by using geostatistics, information theory models and Monte Carlo randomizations.

Results: Consistent assembly rules were found over time and between spatial replicates. However, frequency of co-occurrences, plant neighbourhood diversity and degree of spatial dependence varied greatly. Climate extreme (serious drought) appeared as the main driver of temporal variability in these plant assemblages. Drought causes mass extinctions in the populations of dominant grasses, induces multiple pathways of local micro-successions, and regulates indirectly the abundances and interactions of subordinate species.

Conclusions: Dominant species form dynamic percolation networks which regulate co-occurrence patterns, interactions and diversity in subordinate species assemblages. Indirect effects mediated by the varying abundances and patterns of dominant grasses are stronger than direct effects of fluctuating environment on annuals and perennials dicots.

Woody community assembly in Mediterranean novel forests: a perspective from metropolitan landscapes

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Background: The Metropolitan Region of Barcelona (Spain).

Objectives: Community assembly in Mediterranean novel forests from metropolitan areas is largely unknown. Using a regional scale approach, this paper is aimed at exploring if: (i) there are differences in woody species richness suggesting an immigration credit in novel forests; (ii) woody species composition is related to different factors, indicating contrasting community assembly processes; (iii) species traits modulate these processes.

Methods: Using the Spanish forestry inventory, historical and recent land cover maps, we evaluated the differences in woody species richness in old (existing in 1956) and novel (appeared subsequently) forests in the study area. Through GLM, we analysed the effect of environmental correlates upon species richness, considering also life-forms and dispersal syndromes. The association between species composition and forest type was assessed using a CCA on species presences and environmental correlates.

Results: No significant differences were found in woody species richness between the two forest types, except for long dispersal species that exhibited significantly lower species richness in novel forests. Species life-traits have a minor modulating effect on immigration credit and community assembly. Woody species composition is mainly associated with rainfall and spatial variables in old forests, and with landscape variables in novel forests. Novel forests are mainly assembled by species typically found in open habitats.

Conclusions: Community assembly in novel Mediterranean forests is fast enough to have accrued the majority of immigration credit, except for that of long-dispersal species (zoochorous), in only 50 years. This suggests a rapid forest recovery from a random pool of woody species capable of persisting in the nearby scrubland patches and hedgerows. Further processes of species colonization in these forests would depend on specific dispersal vectors (birds, mammals) which might be constrained by the loss of the open habitats from the surroundings.

Poster E157

Are fire, soil, water availability, plant functional diversity, and litter decomposition causally related in a Neotropical savanna?

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Understanding how biodiversity and community functioning respond to changes in the environment is fundamental to the maintenance of function. In realistic scenarios, the biodiversity-community functioning pathway may account for only a small share of all factors determining function. We investigated the strength to which variations in environmental characteristics in a Neotropical savanna affected functional diversity and decomposition. We sought an integrative approach, testing a number of pairwise hypotheses about how the environment, biodiversity, and functioning were linked.

We used structural equation modelling to connect fire frequency, soil fertility, exchangeable aluminium, water availability, functional diversity of woody plants, and litter decomposition rates in a causal chain. We found significant effects of soil nutrients, water availability, and aluminium on functional diversity and litter decomposition. Fire did not have a significant direct effect on functional diversity or litter decomposition. However, fire was connected to both variables through soil fertility.

The mediated effects that emerged from pairwise interactions (for example, biodiversity-community functioning effects) are encouraging for predicting the functional consequences of changes in environmental variables and biodiversity, but also demand caution against predictions based on only environmental or only biodiversity change. In sum, we showed that soil fertility, aluminium, and water availability had significant direct effects on functional diversity and litter decomposition rates. Soil fertility mediated the indirect effects of fire on functional diversity and litter decomposition rates. By simultaneously considering the pairwise effects between our variables, we uncovered a number of indirect effects, which often acted in opposition to direct ones.

Eco-complexities in the Indian Biodiversity hotspots

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Biodiversity hotspots have significant role in conservation ecology; therefore understanding of ecological complexities of individual hotspot eases achieving both scientific and management objectives. Here, we have attempted to analyse the pattern of relationships of endemic and ERT (endangered, rare and threatened) species distribution with (i) different forest vegetation type groups, (ii) forest fragmentation, (iii) demography, (iv) topography and (v) climate variables in all the 4 world biodiversity hotspots that the India accommodates. We gathered the endemic and ERT species distribution for the Himalayas, Indo-Burma, Western Ghats and Sundaland hotspot areas using proportionately stratified random sampling method within Indian geographic extent that revealed the highest species richness, endemism and ERT species occurrence for the Himalayan hotspot. Utilization of the satellite image derived forest vegetation type groups led to understanding of the variability in the hotspots with respect to all the natural, semi-natural, plantation and disturbed communities. Evaluation of forest fragmentation and population density of the hotspots explained varied pattern and relationship with forest vegetation and their species content. We observed that simpler terrain accommodate higher species richness in contrast to their endemic and ERT subsets. However, the islands of Sundaland demonstrate higher species richness as one move away from the coast. Climatologically, average rainfall and minimum temperature appears to be playing critical role in Western Ghats and the Himalayas in shaping the biodiversity. Finally, the question, 'do diverse forest vegetation communities accommodate higher number of endemic and ERT species?' was answered with different patterns that can be explained neither by any one factor, but by combination of many of them accounting to ecological and biological complexities.

The role of within- and between-site heterogeneity for biomass production in Central European managed grasslands

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The interrelationship between biodiversity and ecosystem functions such as productivity was mainly focused on various aspects of alpha-diversity. Besides species richness, functional diversity such as the number of functional groups was measured and related for instance to biomass. Most of the ground-breaking studies and experiments were affected in temperate grasslands. Central European grasslands are known to exhibit enormous species richness at small scales (Wilson et al. 2012). In these ecosystems, and especially in managed hay meadows, small scale units of vegetation may vary in species composition and functional traits. In addition to plot-related values at the level of one square meter, spatial heterogeneity within communities plays a major role for the performance of grasslands, which can be taken again as a case study for general traits of ecosystems. In grasslands small-scale differences in species composition may reflect previous disturbances, local soil specifics, and the legacy of individual species and populations.

Following a standard protocol for coordinated biodiversity assessments (see also Fraser et al. 2013), we recorded species identity and biomass at the site level (six sites with 8 × 8 m each) and within sites at the plot level (one square meter). We focus on 6 sites in Northern Bavaria. All sites are located near Bayreuth within less than 5 km in distance. Climatic conditions are comparable. Precipitation reaches about 700 mm p.a. and annual temperatures are 8 °C in average. The plots of this study are located in close vicinity to the former BIODEPTH plots in Bayreuth, where important studies on the biodiversity – ecosystem functioning debate were carried out (Hector et al. 1999). Current studies on the succession of these experimental plots have shown strong individual behaviour on near-by plots on the same substrate (Kreyling et al. 2011).

Here, we analyze the spatial patterns of beta-diversity in extensively used grasslands (no fertilization, one to two harvests per year). Two replicates were installed on low fertile, intermediate and high fertile sites, each. Fertility, however, is driven by the substrate and water availability only, not by anthropogenic fertilizer input. In addition, we relate the intrinsic floristic heterogeneity of the vegetation to fertility gradients.

The aim of this study is developing approaches for heterogeneity measures in coordinated biodiversity experiments.

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Inconsistent co-occurrences in *Eleocharis* species in shallow temporary lakes: Is this packing and unpacking of niches in space or competitive coexistence?

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Four *Eleocharis* species occur in a series of shallow temporary lakes in northern NSW, Australia but spatial patterns of species abundance and co-occurrence in these clonal sedges are inconsistent within and among lakes. A field experiment on species interactions suggested that fluctuating water levels prevents competitive exclusion in some but not all species. We sought explanations for inconsistencies in space by examining patterns of co-occurrence at a range of spatial scales.

Distribution and abundance of each species was examined over four summers by sampling culm frequency with a point quadrat at five spatial scales. The spatial niches of all four species broadened and overlapped in the smaller lakes but niches of three species (*Eleocharis acuta, E. dietrichiana* and *E. pusilla*) narrowed in the larger lakes. Tabulation of co-occurrence data showed that these three species co-occurred at a range of scales towards the edges of all lakes. Although distributions were patchy, co-occurrences were present to some degree at such small scales that an overlap of heterogeneous niches in space is unlikely to explain coexistence in these instances and some other explanation needs to be sought. The relative importance of disturbance, species interactions and niche expansion and contraction to coexistence in these clonal species is explored. Stochastic niche theory and the spatial storage effect appear to have limited application to communities where clonal species are dominant.

Context dependency in AMF effects on diversity: The role of resource stoichiometry

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Arbuscular mycorrhizal fungi (AMF) are generally thought to enhance plant diversity, although these effects vary with phosphorous availability and the mycorrhizal dependence of the dominant and subdominant species. However, co-limitation among multiple resources can determine the outcome of individual plant-AMF interactions, suggesting that multiple resources could also determine AMF effects on diversity. To test whether co-limitation among multiple resources determine AMF effects on diversity, we established a 5 year factorial experiment applying fungicide (Rovral®), adding NPK fertilizer, and removing plant litter in spatially heterogeneous native grassland limited by nitrogen and water availability. We found that AMF had little effect on diversity in the absence of the other treatments, which is consistent with previous results from communities without dominant species. However, AMF increased plant diversity following fertilizer addition, but only when litter was removed. This stabilizing effect of AMF on diversity following eutrophication is consistent with previous work, but the interaction with litter suggests a certain amount of complexity. To further explore this pattern, we used measurements of nitrogen, phosphorus, water, and light availability taken in the plots to determine which resources influenced AMF effects on plant diversity using both absolute resource availability and pairwise resource ratios. We found that resource stoichiometry, rather than absolute resource quantities, best explained AMF effects on plant diversity. Interestingly, none of the ratios that explained AMF effects contained phosphorus. Specifically, AMF increased the number of coexisting plant species under three sets of conditions: low water relative to light, low water relative to nitrogen, and low light relative to nitrogen. In drier environments, AMF likely increase access to nutrients for plants that would otherwise be resource limited. Similarly, when nitrogen is abundant, diffusion is unlikely to limit uptake, and plants are more likely to be phosphorus limited without AMF. Further, the importance of AMF for plant diversity under low light and high nitrogen, although surprising, suggests that light does not limit diversity in this system as long as AMF are intact and there is sufficient nitrogen. Overall, we suggest that experimental and theoretical exploration of community-level plant-AMF interactions should broaden its scope to include resource stoichiometry beyond nitrogen and phosphorus.

Alpine treeline and the impact of humans since Subatlantic in High Sudets

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Hruby Jesenik represents one of the mountains with developed alpine timberline within High Sudetes. However, the extent of alpine forest-free areas in Central Europe is probably influenced by both climate and human activities. This study tries to reconstruct conditions at the locality and development of treeline position and to find out, how humans affected the formation of forest free areas. We used combination of pollen and macrofossil analyses of two cores combined with pedoanthracological methods taken from high elevation sites.

The first possible human impacts at the highest altitudes of the East Sudetes are likely indicated by charcoal and perhaps also by the formation of ombrotrophic mires at the end of the Iron Age. Fir-beech forest with spruce was present since the beginning of Subtlantic. Period since ca 1000AD is characterised by increase of spruce pollen and decrease of fir, beech and hornbeam accompanied with plenty of spruce needles and seeds and decrease of sedge nutlets in macrofossils. Treeline limit was evidently above the level of Mezikotli site. AP/NAP ratio decreased continually since 12-13th century which is very probably caused by anthropogenic impact.

According the results of anthracological analysis first burn was dated to the Iron Age. There are no doubts about the human-induced burning of tree growths on summit plateaus during the second half of the early Middle Ages (ad 800–1000). Nevertheless, the effects of those fires were probably rather local. The current extent of forest-free areas in the East Sudetes has largely resulted from past human activities. Before human-induced alterations, naturally forest-free patches were probably restricted to exposed summits, the convex margins of summit plateaus and to avalanche tracks. At the same time, summit plateaus were overgrown by open canopy tree growths dominated by *Picea abies* with frequent heliophilous tree species, diffuse into *Picea* forests on adjacent slopes.

Effects of plant diversity on Arbuscular Mycorrhizal Fungi community structure: a wide-scale experiment based on mesoscom cultures

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Most plant species have developed symbiotic interactions with arbuscular mycorrhizal fungi (AMF). This mutualistic interaction which is arguably the most widespread on earth plays a major role in ecosystem functioning since AMF support in average 70% of the nutrients acquisition including phosphorus. AMF diversity in soil is known to influence plant species diversity. However the reciprocity of this relationship remains poorly understood.

Our study aims at determining whether the specific richness of the plant community determines the structure of the AMF community. In particular we are interested in the spatial scale at which AMF community structure responds to plant diversity.

We used an experimental design constituted of 140 mesocosms testing 14 different plant assemblages. These simplified plant communities differ by their species number and composition. We sampled soil chores to be used as a substrate for the individual cultivation of *Medicago truncatula*, which is a generalist host for AMF. Plant distribution in each plot was mapped with a 5 cm resolution grid. We used GIS system to determine plant composition in the neighbourhood of the soil sample at different space scales. The diversity of AM fungi was analysed in roots of *Medicago truncatula* bioassay seedlings grown in the soil samples allowing direct comparisons of AMF propagules diversity across mesocosms treatments. Total DNA was extracted from roots. After a SSU rRNA gene amplification step for AMFa 454/Roche pyrosequencing was performed to assess to the exhaustive composition of the AMF community. We will present new results about (1) how plant landscape could impact on AMF communities and (2) the possible relationships to spatial heterogeneity.

Plant ecological niche distribution along heavy metal gradients

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Why species do not occur everywhere? The concept of ecological niche is central to understand relationships among biotic/abiotic factors and species distribution. Gradients of environmental stress associated to interspecific interactions generate testable patterns of specie's response curves. Distribution of response curves have been seldom tested along toxicity gradient, in contrast to resource gradients. On Katangan copper hills (south R.D.C.), natural copper and cobalt concentrations span a large range: 2 - 1000 mg/kg for cobalt and 30 - 10 000 mg/kg for copper. In this study, we evaluate three hypotheses related to niche distributions and shapes along metal toxic gradients: (1) Species optima are uniformly distributed over copper-cobalt gradient. (2) Realized niche width varies in relation to the niche optimum along copper and cobalt gradient. (3) Absolute values of skewness coefficient are higher when plant species optima are in the extremes of cobalt gradient with a niche tails toward mesic conditions.

Realized niches of 80 taxa were modeled with general additive models (GAM) using presence/absence data in 172 1 m² plots. Niche optima, niche widths and skewness coefficients were estimated from species response curves.

The three hypotheses were globally validated. Three groups of species were distinguished according to their optima position along metal gradient with packed optima on intermediate concentrations suggesting higher interspecific competition in low metal concentrations. Niche width increased with metal concentrations. Highest metal tolerant plant species had broader niches and skewness coefficient was inversely related to niche optima positions. Our study demonstrates that species distribution pattern on toxicity gradient presents similarities with resource gradient. Broad realized amplitude of species adapted to high levels of copper cobalt concentrations suggests that fundamental niche of specialist metallophytes may be larger than expected. This should be further tested in controlled conditions in association to competition tests.

High reproductive efficiency as an adaptive strategy in competitive environments

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How plants allocate resources to reproduction across environments varying competition is central to our understanding of adaptive strategies. Plant strategy theory predicts that reproductive allocation and reproductive efficiency (the conversion efficiency of resources from vegetative tissue to reproductive output) should decrease under competition. For example, intense competition is predicted to favour the presence of relatively long-lived species in plant communities, and these species will delay reproduction in favour of growth and resource acquisition under intense competition. Contrary to the predictions of traditional plant strategy theory, short-lived semelparous species are frequently observed to live in highly competitive environments. Further, relatively long-lived iteroparous species often allocate heavily to reproduction in competitive environments. Here, I use life history theory to advance a prediction that reproductive allocation and efficiency should increase under intense competition for both short-lived and relatively long-lived herbaceous plants. I surveyed the literature for studies on plants including measurements of vegetative and reproductive allocation in high and low competition treatments. Across species, allocation to reproduction increased with increasing competition intensity. Patterns of allocation to reproduction under competition support the existence of a competitive annual strategy and a reproductive perennial strategy. The competitive annual strategy suggests that competition plays a major role in shaping adaptive strategies of many short-lived plant species. The reproductive perennial strategy is favoured under conditions where competition slows growth and increases mortality of severely competitively supressed iteroparous plants. Competitive strategies, where plants delay reproduction in competitive environments in order to gain competitive superiority, are favoured not under intense competition but under modest competition. Including a life history interpretation in reproductive efficiency under competition provides a much needed predictive framework for strategies of reproduction in competitive environments observed across species.

Poster D100

Plant communities with *Carex dioica* L. in Ukraine

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Carex dioica L. is the Eurasian species which area occupies the territory of North and Middle Europe and Siberia. On the territory of Ukraine it is considered as a rare boreal species, being on the southern limit of its distribution. It is included in the Red book of Ukraine; the decrease of its localities is observed that is a great threat for the existence of the species. According to our data most of the localities on the territory of Forest-Steppe zone and Podillia are considered to be extinct since they have not been confirmed for more than 50 years.

The main area of *C. dioica* in Ukraine occupies the territory of Western Polissia (less than 15 localities) where 2 new localities have been detected. The most southern isolated habitat of the species was found in the highland of Svydovets massif (the Ukrainian Carpathians).

The aim of our research was to determine chorologic, ecological and population peculiarities of the species, as well as to establish syntaxonomic position of the communities with its participation. The research has being conducted during 2010-2012. As a result, 10 localities of the species have been investigated and 30 phytocenotic descriptions have been made.

C. dioica is a typical representative of boggy ecotypes. It mainly grows on the moderately watered acidic mesotrophic and oligomesotrophic sphagnous bogs, forming small clumps. According to different authors it is considered as diagnostic species of *Scheucherio-Caricetea nigrae* class and different lower unites. As a result of phytocenotic data processing with use of JUICE 6.3 for Windows programme and their identification according to critical revision of literary sources it was established, that communities with participation of *C. dioica* belong to 3 orders, 4 unions *(Caricion lasiocarpae, Caricion canescenti-nigrae, Sphagno-Caricion canescentis, Caricion davallianae)* and 5 associations of this class. Its ecological optimum is observed in the communities of *Caricion lasiocarpae* and *Sphagno-Caricion canescentis* unions. Most of *C. dioica* populations on the territory of Polissia, Podillia and in the Carpathians are critically endangered while only some of them are stable and viable. Almost all the detected localities belong to Natura 2000 habitats, in particular, 91D0* Bog woodland (priority habitat type), 7140 Transition mires and quaking bogs, 7230 Alkaline fens, therefore they need constant monitoring and protection. For the effective habitats conservation these localities it is necessary to maintain the appropriate hydrological regime of bogs and to prevent succession stages towards afforestation.

Poster B71

Detecting simultaneous effect of environmental filtering and limiting similarity to the trait composition of plant communities

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Ecological theory predicts that community composition is formed by two forces: environmental filtering and limiting similarity among co-existing species. Environmental filtering leads to convergence, while limiting similarity leads to divergence in the trait-space. The functional convergence/divergence could be detected by comparing observed functional diversity with its value predicted by null models. It is still open question what is the appropriate test statistic (functional diversity index) and null model. Environmental filtering and limiting similarity may influence the same trait in the same community assembly. The aim of this research is to find an appropriate test in such situation.

For this purpose artificial communities were generated by individual based simulation where both processes operated on independent or correlated traits or on the same traits. Different functional diversity indices and null models were involved in the comparative study. Power of the statistical tests and Type I error rate (based on neutral traits) was estimated for each possible combination of functional diversity indices and null models.

Main conclusions: Rao's quadratic entropy is suitable index for detecting both functional divergence and convergence. Detecting trait convergence needs data from heterogeneous environment. The suitable null model is randomization of trait values among species. Trait divergence is more easily detected if environmental heterogeneity is low. The recommended randomization method is the re-shuffling non-zero abundances within plots. Note that it is compatible only with abundance based functional diversity indices.

Determinants of Herbaceous Species Richness across Eastern North America

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Identifying determinants of plant species richness has elusive because richness sometimes peaks in intermediate situations and because individual vegetation layers respond differently to environmental conditions. The herb layer often contains the most species and can be studied well by plot-scale studies, since herbs are especially sensitive to finer-scale conditions.

Factors affecting herbaceous richness can be suggested from geographically diverse plot data-bases, as from the Eastern North American Vegetation Survey, which also includes information on site slope, topographic position and rockiness; soil texture, depth, organic content and moistness; litter-layer depth and quality; and estimated inundation periods. Earlier analysis had shown little correlation between species richness and climatic variables, even when wetlands and other topogenic situations were excluded. Instead it appeared that richness may be related more to overlying vegetative cover and to substrate properties.

For this study, plots were sorted by physiognomy, topographic province, and then by site physical conditions, into groupings that show richness patterns in different substrate and habitat situations of mountain, coastal and intermediate regions. Particular situations include lower and upper slopes, rocky slopes and flats, sand substrates, wetlands, floodplains and other inundated sites.

Results show inter-layer patterns of height, cover and species richness as well as relationships of herb-layer richness to substrate conditions that are not revealed by purely statistical treatments. Forest overstorey and understorey cover are inversely related but sometimes vary more widely in poorer stands. Understorey richness is only sometimes related to cover and often varies widely within stands of similar physiognomy.

On the other hand, some vegetation types show fairly consistent species richness levels, including pinewoods, longer-flooded floodplain forests and swamps, boreal woods, bogs, riparian and littoral meadows, sand scrub, and aquatic vegetation. Greatest total species richness appears in bottomland forests but also some upland forests. Richness is consistently low in laurophyll forests and seems inversely related to depth and duration of inundation. Plot size does not show a large effect on richness. Canopy richness and stand dimensions are generally related to climate. Results herein, however, suggest that herbaceous richness drives total richness and is related to substrate characteristics and local relief much more than to climate or overlying vegetative cover. Herbaceous richness can be consistently high or low in expected and some unexpected situations.

Impacts and underlying factors of landscape-scale historical disturbance of mountain forest identified using documentary archives

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Large areas of temperate mountain spruce *(Picea abies)* forests in Central Europe were disturbed by wind-storms during last two decades. As windthrow event in spruce stands is usually a trigger of bark beetle (Ips typographus) outbreaks, many forests stands became threatened by bark beetle infestation and millions of canopy trees died in nature reserves, where salvage logging was not applied. It raised a question on historical range of variability of forest dynamics in this region, as disturbances were traditionally perceived as non-natural in Central Europe and without strong relevance for the forest development. Well documented large scale disturbances, which occurred during second half of 19th century, can help us understand their role in the long term dynamics of these mountain forest and shape current nature protection strategies in the area. We have used available historical forest management maps to analyse the landscape level effect of 1868-1870 disturbance events on the mountain spruce dominated forests. Our new cross boundary forest stands database of Bohemian Forest covers 54 974 ha of National Parks Šumava and Bavarian Forest. It includes species composition, age and disturbance intensity.

To infer important factors responsible for occurrence of disturbance we constructed a regression model relating disturbance intensity to two groups of explanatory variables: characteristics of forest stand and environmental, mainly topography derived factors. Age class was identified as the most important factor with positive effect, followed by latitude, meaning more intensive disturbances in older stands and in northern areas. No significant topographic variable was identified. A model without any stand related characteristics identified elevation and Effective Air Flow Heights from constant wind direction of 90° as the most important, but with limited prediction power. Separate analysis of disturbance intensity among elevation gradient revealed increasing disturbance intensity with elevation only up to 1000 -1150 m, and then decreases again. The high importance of age class on the disturbance intensity shows how important the age structure of the forest is, for the disturbance to happen on a larger scale. Even the oldest and unmanaged stands were not able to withstand extreme winds and subsequent bark beetle outbreak. The proportion of the oldest class might be one of the factors differentiating large and small disturbances. This knowledge is important for current management, since many of the stands have already reached the oldest age class.

Soil tranfert for restoring plant communities: which lessons to measure the resilience of dry grasslands (Plain of La Crau, Southeastern France)

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The 7th August 2009, an important pipeline leak occurred in a Mediterranean semi-arid steppe and spilled 4700 m³ of oil. In 2010, over 5 ha of the polluted soil and steppe vegetation were destroyed by excavation and evacuation. Then, the rehabilitation of the steppe vegetation was set up via civil engineering techniques with the transfer of 72 000 tons of the same type of soil coming from a nearby quarry. Various experiments of soil vertical reconstruction testing the importance of respecting the vertical organization of the main soil layers are conducted. In a fundamental point of view, we take the opportunity to test vegetation resilience via it seeds bank and/or propagules according to the different modalities tested. Quadrats (10 × 10 m) were placed at random in each case: the reference steppe (×9), in the zones which include the organic layer (0-20 cm deep) with compaction (×9) or without compaction (×9), the mineral layer (20-40 cm deep) (×9) or only the geological basement (>40 cm deep) constituted by gravels (×9). After three years, our results (2011-2013) show that the soils with the transfer of the organic layer (with or without compaction) and with the mineral layer has the closest vegetation to the reference steppe vegetation in terms of composition, species-richness, diversity and similitude, in spite of the presence of some ruderal species which have germinated from the seed bank and the seed rain. At the opposite, the soil with gravels only has the poorer vegetation that mostly included pioneer species with strong capacity of dispersion. None of the treatments tested allows an ecological restoration in the short term.

Positive interactions and interdependence in the organization of plant communities

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Positive interactions among plants, or facilitation, occur when the presence of one plant enhances the growth, survival, or reproduction of a neighbour. Historically, plant ecologists overwhelmingly accepted the notion that the distributions of plant species, and their organization into groups or communities, is determined individualistically, that is by the adaptation of each species in a "community" to a particular abiotic environment and competition. But in the last 30 years, hundreds of peer-reviewed papers have been published on facilitation by plants on other plants. This explicitly challenges the adequacy of a strict definition of the theory of individualistic communities. If the presence of one species can increase another species' fitness, or the probability that another species will occur in a particular place, plant communities cannot be individualistic. I will discuss the balance of competition and facilitation in specific interactions, local to regional scale effects of foundation species on biodiversity, experiments conducted along environmental gradients, and the potential evolutionary roles of facilitation in the context of exploring the fundamental nature of communities.

Local species specialization along an environmental gradient on Mediterranean coastal dunes

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Ecological specialization refers to a restricted ecological niche breadth for a species, resulting from the trade-off between the range of the resources it can exploit and the efficacy in exploiting a specific resource. Consequently, specialist species are typically expected to be dominant in peculiar or stressful environments, whereas generalist species should be dominant at the less extreme ends of an environmental gradient. We tested this hypothesis by analyzing how the distribution of specialist and generalist species was related to the sea-inland environmental gradient in plant communities of a Mediterranean coastal dune system. We used data on plant species cover in 570 4 m² plots at varying distance from the sea, environmental data on soil features and data on species traits measured on the most common species. We quantified species specialization (niche breadth) based on the plots where the species occurred following four approaches: 1) variability of measured environmental values; 2) variability of community weighted trait means; 3) variability of distance to the sea values; 4) variability of co-occurring species. These specialization indices were then averaged for the different coastal dune habitats identified by Natura 2000. We then analyzed the patterns of variation of habitats' mean specialization values along the sea-inland stress gradient. Where we found significant variation in the degree of specialization along this gradient, habitats closer to the sea and under greater stress held greater proportions of specialized species and had greater average specialization levels. Sheltered backdune habitats harboured both generalist and specialist species, but were dominated by generalists. We conclude that indeed specialist species dominated in the most extreme environmental conditions, while they were subordinate at the less extreme end of the gradient.

Poster A26

Inter-annual fluctuations in water availability promote diversity in semi-arid grasslands

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Understanding how local communities are assembled from the available pool of species and the factors that drive these assembly processes are major goals for ecology. Functional trait diversity has been used to reveal changes in assembly processes along spatial gradients of resource availability and disturbance (Mason et al. 2012b). However, it remains unclear how temporal variation in resource availability interacts with spatial gradients of stress and disturbance to influence assembly processes.

This study uses plant functional diversity to explore how temporal and spatial variations in resource availability interact with grazing disturbance to influence assembly processes in grassland communities.

In Mediterranean grasslands, we surveyed plant communities from 67 sites under different grazing regimes (from heavy grazing to grazing abandonment) in wet and dry habitats in a wet and a dry year. Community weighted mean and Rao quadratic entropy for three key plant traits (specific leaf area, plant height and seed mass) were calculated for each community. We used null models to estimate pure measurements of functional richness and functional divergence, the components of functional diversity with the highest power to detect changes in community assembly processes across environmental gradients (Mason et al. 2012a). Finally, we studied the inter-annual changes experienced by these parameters.

Vegetative traits response was consistent with the expected shift from size-symmetric competition for belowground resources in dry years to size-asymmetric competition for light in wet years. Dry habitats had, on average, shorter species than wet ones, indicating increased importance of competition for light under higher resource availabilities. Functional richness patterns for seed mass contrasted with those of vegetative traits, revealing the simultaneous existence of trait convergence and divergence for different niche axes.

Conclusions: Pulses in water availability were confirmed as a determinant of plant diversity that reduces differences in average fitness between co-occurring species. The primary assembly process structuring communities changed in response to temporal resource fluctuation. We provide a valuable insight into how spatial variation in resource availability and disturbance interact with temporal fluctuations in resource availability to affect shifts in assembly processes.

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Connecting bird and plant functional traits along successional stages of Brazilian Atlantic Rainforest

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Predicting functional responses of communities to environmental changes has recently become a major concern in theoretical and applied ecological research. This study evaluated the connection between functional traits of bird and plant communities in relation to vegetation structure of successional stages (initial, intermediate and advanced) in Brazilian Atlantic rainforest. We used plant and avifauna abundance matrices to scale up species trait information (14 traits of 49 tree species and 24 traits of 69 bird species) to the community level. The variation of both (plant and bird) community weighted means (CWM) of traits were combined by using co-inertia analysis. Analysis of variance was used to verify which functional traits showed significant variation in relation to successional stages and then were further interpreted. The co-inertia analysis showed significant association between plant and bird trait datasets (RV=0.51; p=0.03). The first axis of the co-inertia biplot distinguished initial stage sites from areas in intermediate and advanced stages. Bird traits related to size, feeding habit and foraging stratum were associated to advanced forests: bird CWM showed higher values of total length and wing length, and proportionally more canopy frugivorous, terrestrial insectivore, and understory omnivorous. This pattern was strongly correlated with leaf plants traits (higher values of leaf dry mater content and leaf area), and potential plant height. On the other hand, CWM of initial successional stages were associated to understory insectivore birds, birds with soil and understory nest location, and plants with high values of leaf thickness. Bird morphometric feeding traits (beak length and depth), and plant fruit size were both associated to intermediate and advanced stages. Our results support the conclusion of a strong association of functional trait patterns of bird and plant communities along environmental gradients observed across forests successional stages, which may result in combining influences on ecosystem functioning.

Phylogenetic diversity of urban habitats with different levels of disturbance

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Communities of different urban habitats cover a broad range of different disturbance intensities and thus they provide a suitable model gradient, however, their phylogenetic alpha diversity has been hardly ever studied. We hypothesize that (1) the level of disturbances affects phylogenetic alpha diversity of urban plant communities; (2) phylogenetic structure of species groups with different residence time responds differently to disturbances; (3) introduction of alien species changes phylogenetic structure of urban plant communities.

Data sampling was carried in 2007–2009 in 32 European cities. In each city seven habitats were chosen: central square, boulevard, residential area, housing estate, park, strongly disturbed area with scarce vegetation cover and abandoned area with perennial grassland and shrubs. Plots of 1-ha size were sampled in each habitat type by recording all spontaneously occurring taxa of vascular plants. The phylogenetic tree was constructed for all recorded taxa. Subsequently, for each plot phylogenetic diversity based on phylogenetic distances (avpd, average phylogenetic distinctiveness) was calculated. Phylogenetic alpha diversity (avpd) can be clustered (i.e. significantly lower than random), random or overdispersed (i.e. significantly higher than random). Using a null model which corresponds to random distribution of species, we tested whether avpd value is non-random.

We found that phylogenetic structure of urban plant communities tends to be clustered in all the studied urban habitats. The reason is probably strong environmental filtering. The clustering is strongest in heavily disturbed habitats, which is consistent with our first hypothesis. We also confirmed the second hypothesis that groups of species with different residence time differ in their phylogenetic structure. Phylogenetic alpha diversity of native species tends to be random, whereas diversity of alien species is often clustered in the studied habitats. We assume that the occurrence of alien species is often limited to specific habitats that select phylogenetically related species with similar traits. Phylogenetic alpha diversity increases with the proportion of native species in the habitat. In contrast, archaeophytes reduce phylogenetic alpha diversity of the community. The proportion of neophytes has no significant effect on community phylogenetic alpha diversity, obviously because neophytes include taxa with various degree of relatedness.

Plant community changes along a chronosequence of beech coppice stands, Central Apennines, Italy

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Disentangling the processes of temporal change in ecological communities, in particular distinguishing between immigration and extinction effects, represents one of the most challenging tasks in applied ecology. Such changes in plant diversity and composition were recently documented in forests across Northwestern and Central Europe, but still a lot of mechanisms of species pool maintenance are unrevealed. We test whether vascular species changes occurred between 2006 and 2011 in a pool of beech coppice forests in Central Italy. A total of 57 plots (20 × 20 m) were selected using a stratified sampling design based on the following criteria: age since last coppicing, elevation classes and bedrock (limestone and sandstone). The regeneration age of each forest stand was used to construct a classic chronosequence (ranging from 0 to 95 years). The field data collection was done in 2006 and repeated in 2011. In each sampled plot six vertical layers were distinguished. Cover (%) of each stratum and projection cover of each vascular species was visually estimated. Each species occurred into the sampling units was classified according to Social Behavioural Types, characterizing species with similar preferences to the associated habitats, i.e. based on their similar phytocoenological role as determined by regional synecology and their actual role in the local floras. To test whether community changes had occurred between 2006 and 2011, we used ANOSIM; following significant results we performed non metric Multi Dimensional Scaling. Results shows that community changes have occurred between the 5 years, in particular the differences are driven by changes in tree canopy cover, substrate and aspect. The 'age from last cut' did not show significant effects. The differences in composition are greater the larger the difference in canopy cover, up to a 60% difference, while pairs of patches with higher differences have a slightly lower distance in community composition. Local extinction events were dominated in proportion by non-forest species while local colonization events were dominated by forest generalist species. These results suggests that canopy closure is the main driving force influencing species composition but its role changes in young forest stands where differences in community could depend by different fertility level into the plots, resulting in different rates of canopy closure at the same 'age from last cut'. Finally the forest generalist species seems to be more resistant to the changes induced by coppicing, probably because of their different persistence-colonization strategies.

Predicting the effects of sea level rise on salt marsh plant communities

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Keywords: salt marsh, community, *Salicornia, Aster tripolium*, sea level rise, species richness, halophytes, historical factors

Salt marsh plant communities will be one of the first exposed to predicted increases in sea level. Most of the predictions of responses to sea level rise focus on the habitat or landscape scale, while responses at the community or plant scale are less studied. The objectives of this study were (1) to evaluate the influence of three major environmental variables (elevation above sea level, distance to sea, vegetation age) on vegetation composition, richness and biomass in salt marshes and (2) to predict vegetation changes in 2100 according to different scenarios of sea level rise. In the Bay of Somme (Picardy, France), plant communities were sampled in 1277 1 m² plots distributed in a total of 30 transects randomly disposed perpendicularly to the shore line. LIDAR data were used to determine plot elevation and distance between plots and shore line. Past changes in vegetation cover were reconstructed using historical maps (from the 17th Century) and aerial photographs to estimate vegetation age. Vegetation biomass was estimated using NDVI from Landsat images. We investigated the relationships between elevation above sea level, distance to sea, vegetation age and vegetation composition, richness and biomass using mixed models. Predictive models of species richness, biomass and cover of dominant halophyte species were built using the parameter estimates of the previous mixed models and the extrapolations of explanatory variables in 2100 according to different sea level scenarios from +0.5 to +2.5 m. Mixed models showed that species richness increased with vegetation age; biomass increased with elevation and age, and decreased with distance to sea. Halophytes exhibited contrasted patterns along elevation and age gradients. As the sea level rises, the vegetation cover decreases in the bay but the proportion of ancient vegetation increase. Consequently, mean plant species richness will be higher in predicted community in 2100 than in recently sampled communities characterized by higher proportions of pioneer vegetation. Among the 1277 sampling plots, only 325 of them will remain above the sea level with a sea level rise of +2 m in 2100.

Can We Infer The Invasion Credit From The Native Species-Area Relationship?

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Area is a major determinant of species richness and its role has been largely investigated and modelled. The objective of this study was to test if an invasion credit by alien species can be identified as an effect of negative residuals in the native species-area relationship. The hypothesis to be tested is that higher the negative departure from the native species-area relationship higher the invasion credit by alien species.

A total of 355 forest patches, varying in size from 0.06 ha to 174.48 ha were sampled in 9 different landscapes of Picardie, Northern France, differing in forest cover and agricultural management. A complete census of species was obtained for each patch, as well as other environmental data. Each species was classified on the basis of its origin (alien or native) or its ecological role (forest herb, non-forest herb, woody).

A total of 515 native and 110 alien plant species were recorded in the investigated forest patches. Alien species showed significantly lower frequency than native species. A significantly higher richness of woody species and lower richness of forest herb and non-forest herb species was found in alien species. Species-area relationships were significant for both native and alien species: The alien species-area relationship showed higher slope, but its predictive capacity was much lower than the native species-area relationship. Contrary to the stated hypothesis, the covariation in residuals of the native and alien species-area relationships were positively related, suggesting that both these groups of species similarly responds to the same factors and the filling of space by native species does not act as a limiting factor for alien species. The richness of native species thus does not limit the richness of alien species.

Distribution and species composition on Chinese juniper communities in Ulleung Island, Korea

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There is very unusual vegetation dominated by *Juniperus chinensis* in Ulleung Island. Present study is to figure out its syntaxonomy and syngeography. The *Artemisio-Loniceretum* juniperetosum chinensis and three variants were identified as endemic vegetation on the coastal cliffs in Ulleung Island. The most diagnostic species were *Juniperus chinensis, Lonicera morrowii,* and *Sedum kamtschaticum* var. *takesimense.* The subassociation was subdivided into three variants such as typical variant, *Sedum kamtschaticum* var. *takesimense* variant, and *Prunus takesimensis* variant. Extremely poor species diversity of phytocoenosen has been resulted from southwestern slope direction, direct damage of typhoon, and shallow soil on the sharply inclined coastal cliffs. Such coastal cliff of Ulleung Island is the most unique habitat as a refuge for Chinese juniper. This subassociation is a pseudo-climax and the oldest plant community in South Korea, which is more than 2000 years old. It was pointed out to establish a long-term ecological site for protecting such vulnerable vegetation against overexploitation and global clime change.

The odd fraction [c] in variation partitioning: a case study on fine scale variation in oak forest herb layer

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After the introduction of Hubbell's neutral theory of biodiversity, partitioning of ecological variation into spatial and environmental components has become a common practice in many ecological studies. Along with the rediscovered dispersal issues, popularization of the PCNM method as a spatial modelling tool has undoubtedly contributed a great deal to this trend. The variation partitioning is believed to give us an insight into mechanisms structuring species distributions, with environmental control (i.e. niche processes) one the one side and dispersal limitation (i.e. neutral processes) on the other. In this line of reasoning, the proportion of so called pure spatial variation (fraction [c]) is usually related to the importance of dispersal processes whereas the environmental fraction ([a + b]) is ascribed to niche filtering. It is then perfectly justified to only collect and compare percentages across communities. Nevertheless, what we regard as a more challenging approach is to subject the popular assumptions to closer scrutiny.

Here, we focus on the assumption that the pure spatial variation represents the strength of dispersal processes. If it was correct, there should be a link between individual species' dispersal traits and pure spatial patterns. In addition to it, we examine the role of neglected environmental variables that can, when incorporated into analysis, considerably reduce the proportion of the fraction [c].

To accomplish these goals, we conducted a fine scale study of understory forest vegetation. We collected data from three plots placed in oak and oak-hornbeam forests located in the south-eastern part of the Czech Republic, each plot represented by a set of 100 2 × 2 m subplots organized in a square grid of 1 ha size. The results indicate that on a fine scale, the link between the fraction [c] and dispersal traits is weak and what seems to prevail is the role of environmental variables.

Species-rich grasslands in Central Europe: search for the causes of the world record species richness

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Semi-dry grasslands in the White Carpathian Mountains of the Czech Republic have been recently identified as the world's most species-rich grasslands for certain plot sizes between 0.004 and 49 m^2. There are records of 67 vascular plant species per 1 m^2, 88 per 4 m^2, 105 per 16 m^2, 116 per 25 m^2, 131 per 49 m^2 and 133 per 100 m^2. Knowledge of the processes responsible for this high richness may significantly improve our understanding of community assembly rules, however these processes are poorly known. To identify possible factors contributing to the high species richness of these grasslands, we compared local environmental factors and species pools of the White Carpathian grasslands with similar (but consistently species-poorer) grasslands in the adjacent regions.

We recorded species composition, climatic factors, soil properties, above-ground biomass production and nutrients in plant biomass in vegetation plots in the White Carpathians and adjacent regions. Although the White Carpathian grasslands were considerably richer in species than the richest grasslands in the adjacent regions, there were no differences in the values of the factors studied that could provide an unequivocal explanation of their high richness. However, the values of these factors were within the ranges reported in the literature as conducive to high species richness in temperate grasslands. Grassland species pool was not higher in the White Carpathians than in the nearby regions, therefore the species pool size must be rejected as a factor responsible for the high local species richness. However, many grassland species are common across this landscape, which results in the formation of grassland communities that are locally rich but with similar species composition among different sites (high alpha but low beta diversity). This pattern may be due to the large total area of these grasslands, which reduces random extinctions of rare species, low geological diversity, which enables many species to occur at many sites across the landscape, and high land-cover diversity, which supports mixing of species from different vegetation types.

We conclude that the high species richness of the White Carpathian grasslands cannot be explained by a single factor. It results from a unique combination of regional factors (long history of these grasslands and specific pattern of landscape diversity), local abiotic factors (soil pH, soil nutrient status, moisture regime and productivity levels suitable for many species from the regional species pool) and regular low-intensity management.

Soil-explained plant spatial patterns along disturbance gradients in South-Mediterranean Spain: Common trends and role in vegetation stability

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The scales of correspondence between spatial patterns of vegetation and those of the underlying soil variables vary among successional stages as a function of the frequency of disturbance, which may interrupt or re-direct succession. We hypothesize that the convergent effect of succession on the reciprocity of spatial attributes (especially patch size, but also high strength-intensity and complexity-number of contributing variables) between soil and vegetation may reduce the spatial heterogeneity at the dominant plant populations scales and increase the stability of the landscape. However, strength and complexity of reciprocal soil-vegetation patches will be restrained at frequently disturbed stages, due to the shortage of relevant plant-limiting soil variables at different community scales.

We selected two disturbance sequences of dry-semiarid-, termo-meso-Mediterranean shrublands from Eastern Andalusia (Spain). In the first sequence, differences among plots are associated to an increasing frequency of fires: >45 yr-unburned garrigue-, 1-burned gorse-garrigue-, 2-burned and 3-burned gorse-shrublands. In the second sequence, topography and land-uses determined the degree of disturbance in a 25-yr period after crop- and grazing-abandonment: *Pinus* reforestation, *Retama-/Artemisia-/*pasture-colonized plots, and semi-preserved *Stipa* vegetation. At each stand, cover of each plant species plus surface soil properties, nutrient concentrations and transformation rates, were analyzed along a ≈70 m-perpendicular-to-slope transect of contiguous quadrats. Strength, complexity and scale of patterns were analyzed using variance partitioning with principal components of neighbor matrices-PCNM.

In both sequences, the relative importance of soil variables for explaining different scales of variance in species composition showed that nitrogen and its processing rates were related to the high ratio of soil-explained/unexplained spatial patterns at the scales of the dominant perennial populations, independently of the disturbance frequency. Litter-fall and microclimatic mineralization-enhancement are consistent with a higher release of available-N below these canopies.

High strength and complexity in soil-explained vegetation patterns were related, respectively, to ammonium-nitrate at large scales in the unburned garrigue/*Retama* units, but to fine scales in the 2-burned gorse/*Stipa* units. The most degraded (3-burned/grazed) plots were characterized by low strength and complexity of soil-explained patterns, and a high importance of organic-inorganic phosphorus at dominant-plant scales. Despite soil crusts and downstream transport create P-rich patches these last patterns may originate from P-limitation at intensively-washed inter-plant scales. These results suggest functional implications of reciprocal soil-vegetation patterns, especially regarding N-cycling, which would promote stability in Mediterranean ecosystems. This effect is associated to the dominance of perennial species in semi-natural landscapes, independently of their life-form (shrubs/rhizomatous herbs), type or frequency of disturbance.

Poster B72

Fine scale community assembly along a stress gradient on Mediterranean coastal dunes

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Understanding how changing environmental conditions influence plant community assembly processes (such as biotic interactions and habitat filtering) is a major challenge in community ecology. The varying importance of different assembly processes along environmental gradients can be inferred by analyzing functional trait divergence and convergence patterns, reflecting how much species differ, or resemble each other, in terms of their traits. We examined trait convergence and divergence between coexisting species at a fine spatial scale (50 × 50 cm) over 14 transects laid along a sea-inland environmental gradient on a central Italian coastal dune site. Along each transect we recorded species composition and abundance in three 4 m² plots (corresponding to three Natura 2000 coastal habitats) divided into 16 quadrats. For each plot we recorded environmental parameters linked to the sea-inland stress gradient (soil humidity, salinity and pH) and we estimated within-plot environmental variability. We collected data on leaf, height and seed traits (LHS), taking intra-specific functional variability along the transects into account. We estimated species spatial aggregation within each plot and then related it to species functional dissimilarity through mantel tests and randomizations. We found that patterns of trait divergence and convergence were contingent on the functional niche axis considered and on the environmental conditions of the plot. For example, convergence of similar species was the dominant pattern in these environments for plant height, with increasing convergence at the most arid end of the gradient. We hypothesize that this was more in relation with biotic interactions (likely because short species with low competitive ability for light were excluded by taller species) than with micro-habitat filtering within the plot, as there was no significant correlation with within-plot environmental heterogeneity. Our study highlights the importance of considering both between and within plot environmental variation, and combine this with specific intraspecific trait measurements, when making inferences on community assembly processes.

Poster E159

Database means compared to on-site measurement of traits

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In functional ecology trait-based approaches are widely used. Gathering on-site measurements of traits can be very laborious, therefore, using traits retrieved from regional or global databases as proxies appears a convenient solution. However, many traits show intraspecific variability in trait values. Thus, using species mean trait values might lead to skewed patterns in traits and by that misinterpretations. The extent to which this is a problem probably depends on geographic scale, level of trait aggregation, type of process and habitat type.

If we knew when it would be possible to use mean trait values of species from regional or global databases as an accurate proxy for on-site trait values of individuals, local-level experiments could be conducted without the often laborious task of measuring the functional traits of individual plants for each sampled community.

Using data from two grassland sites, a salt marsh and a wet hay-meadow, we analysed the effect of species mean trait values retrieved from a regional database on the resulting trait structure of our plant communities. We compared on-site measurements from a 2 × 2 m scale with species mean traits aggregated per site (i.e. the habitat species pool), and those retrieved from a regional database (the LEDA trait database). We focused on the commonly used morphological plant traits canopy height, specific leaf area, and leaf dry matter content.

Our results show that database values are more accurate in predicting the trait values in the habitat species pool as compared to the community mean traits aggregated per 2 × 2 m plots. The performance of database values also depends upon the trait and habitat type considered, as we show that traits with a high plasticity and traits in stressful habitats are being less accurately predicted. We can also explain why species trait means generally show a skewed representation of community traits as not only species composition, but also the individuals within species influence the community means. For studies focussing on processes mainly acting at the site scale (e.g. trait-environment relationships) traits retrieved from a regional database and filtered according to habitat will probably lead to reliable results. In contrast, studies focussing on processes acting at the plot scale (e.g. niche partitioning), require the additional effort of measuring traits on-site.

A novel approach to determine the environmental niche of species that are not at equilibrium with their environment

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Ecological niche models assume that species are at equilibrium with the environment and thus occur in all environmentally suitable areas. These models also assume that data is not spatially autocorrelated. In many cases these assumptions are not met, especially in the current context of fast global environmental change and taking into account that some parts of the geographic space of species are better sampled than others. In areas of the globe where humans manage large proportions of the landscape, such as in Europe, species will likely have distributions that have been artificially manipulated. We use two novel methodologies (that will be presented in the special session *Niche-based approaches: tackling the link between environment and biota*) to determine the environmental niche of species that are not at equilibrium with their environmental space. This approach has two phases: (i) identify the maximum non redundant set of locations (derived from graph theory: the maximum independent set) that reflect the range of environmental conditions that the species occupies, in order to remove potential geographical and environmental biases found in data sets and expectably better characterize the niche of the species and, (ii) using this set of locations, identify the environmental niche of the species based on the CH-approach using Tukey's depth. We will illustrate this methodology with two traditionally managed Quercus species: *Quercus suber* and *Quercus rotundifolia*. These two species are the support of the *Montado* or *Dehesa* systems, which span across much of the Mediterranean Basin, and are considered High Nature Value Farmlands due to their important social, economic and ecological roles in the region. Thus, by using this approach, we can characterize the current environmental niche of these species, and also predict potential future changes in the geographical distribution of the more suitable areas due to climate change. For both species, our results indicate that the core environmental niche areas will generally move northwards, towards areas where the species are currently rare or absent. As these are economically important species of slow-development (e.g. Cork oak *Quercus suber* takes approximately 30 years to start producing cork), our results also suggest that plantation of cork oaks in the new environmental suitable areas should be prioritized by governmental policies and land managers.

Poster E155

Effect of sea level rise in a temperate Atlantic estuary salt marsh plants (Portugal)

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In the last 250 years, industrial activity has increased with a concomitant increase of the fossil fuel usage and consequent atmospheric CO_2 increase. This has recognized consequences on climate change, namely increasing the global surface temperature. Coastal wetlands, such as salt marshes have high productivity, being one of the most productive ecosystems in the world and are good carbon sinks, helping mitigate the greenhouse effects. Because the mentioned above, it is important understand the effects of the sea level rising on these systems. The Mondego estuary is a temperate system located in the central Atlantic coast of Portugal (40°08`N, 8°50`W). Its terminal part, with 7 km long and 2–3km across at its widest area, consists of two arms (North and South) with very different hydrological characteristics, separated by the Murraceira Island. The South arm is shallower than the North arm (2–4m during high tide), is characterized by large areas of intertidal mudflats (almost 75 % of the area) exposed during low tide. The objective of the work is to see if the sedimentation rate at each studied species area is enough to maintain these species above of the sea level in the next years; and if not, calculate the loss in terms of carbon accumulation. The carbon pool and biomass of three saltmarsh species - *Scirpus maritimus, Spartina maritime* and *Zostera noltii* - were determined for 7 seasons (spring of 2010 until autumn of 2011). The sedimentation rate was also determined for one-year period to compare with the sea level rise. Was assumed that the observed sedimentation rate for one year is the rate for all years; was not taked into account others factors that could change the rate. The three studied species presented higher carbon pool in the warmer seasons than in the cold seasons and *Scirpus maritimus* and *Zostera noltii* had seasonal differences. The sedimentation rate varied between 0.2 to 2.7 cm. The biomass results are corroborated by several others studies. The literature shows that in worses scenarios the sea level can rises about 0.9 cm per year, which put in risk some areas of the Mondego salt marsh and the carbon accumulation of the system, which is approximately 38 kg of carbon per day.

Poster D116

Nitrogen sequestration in Mondego estuary salt marshes illustrated by an isotopic approach

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Salt marshes are among the most productive terrestrial ecosystems and provide crucial ecosystem functions, such as nitrogen sequestration. On the other hand, nitrogen is most often the limiting nutrient of primary production in coastal marine ecosystems. Salt marsh plants play an important role and promote several oxidation/reduction reactions leading to N based nutrients dynamics between plant and sediments.

The Mondego estuary is a temperate system located in the central Atlantic coast of Portugal (40°08`N, 8°50`W). Its terminal part, with 7 km long and 2–3 km across at its widest area, consists of two arms (North and South) with very different hydrological characteristics, separated by the Murraceira Island. The South arm is shallower than the North arm (2–4 m during high tide), is characterized by large areas of intertidal mudflats (almost 75% of the area) exposed during low tide. In this paper we discuss the role of *Zostera noltii, Scirpus maritimus* and *Spartina maritime* (that occupy approximately 50% of the salt marsh area together with the other two species) in the N storage in the salt marsh of the Mondego estuary illustrated by a stable isotopic approach. Pure stands of *Zostera noltii, Spartina maritime* and *Scirpus maritimus* were sampled every season of 2011 at Mondego estuary. Three sediments cores were also taken at each species site using a tubular probe with 8 cm diameter for sampling the first 30 cm, which contains the majority belowground components. With the samples proceeded to the biomass analyses of the above and belowground part of the studied species and the isotopic analyses of these parts and the sediment. The N pool was higher in the aboveground than in the belowground organs, but the species *Zostera noltii* presented close results between these parts. *Zostera noltii* had the highest N concentration in the sediment, followed by *Spartina maritime* and *Scirpus maritimus*. The isotopic signatures showed similar results for all studied species. Occupying about 50% of the Mondego salt marsh area, the three species together can store in their tissues about 1700 kg of N and 9000 kg in the sediment.

Development and implementation of a monitoring concept for the effectiveness control of nature conservation management in the Natural Heritage of Germany

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The German National Natural Heritage (NNH) comprises ca. 125,000 ha of outstanding protected areas in natural and semi-natural environments all over Germany. Approximately 60,000 ha of this land are privately owned by the German Federal Foundation for the Environment (DBU). About 70% of this area is also part of the European Natura 2000 protected areas network. The long-term perspective is that natural processes will govern about two-thirds of the land (wilderness areas), but highly valuable man-made habitats will be further managed. The main nature conservation management instruments of DBU Natural Heritage are (1) the statutory general principles of nature conservation, (2) NNH management plans including ecological base surveys, and (3) a monitoring system for effectiveness control with reporting commitment. Founded in 2007, DBU Natural Heritage has taken the opportunity of cross-linking these instruments in a comprehensive planning and implementation approach. The first objective of this presentation is to introduce the overall ecological base survey and monitoring concept on DBU Natural Heritage sites. The concept includes nine modules, which are categorised by the underlying conservation strategy (conservation of man-made habitats, protection of natural processes), vegetation form (forest, open habitats, transition habitats) and scale of observation (entire area, representative sampling sites, data counting areas). Within the modules, methods such as vegetation mapping, surveys of endangered species and forest naturalness assessment are applied. An integrative approach is followed in the development of meaningful indicators by pre-screening existing indicator sets. The second objective is to present a standardised vegetation mapping and monitoring protocol. The methodological challenge arises from the federalism of Germany. In Natura 2000 protected areas habitats should be mapped according to the varying survey approaches established by the states' conservation agencies in order to make management plans compatible. On the other hand, the broader spectrum of conservation objectives as defined by the general principles demand for broader and more detailed monitoring data. Moreover, data should be comparable over all NNH sites for general analyses. This was solved by (1) standardising the survey methods to the highest resolution, (2) harmonising the different systems of habitat/vegetation codes, and (3) introducing additional parameters. The successful implementation of the protocol is demonstrated by results of completed vegetation surveys from DBU Natural Heritage sites. Conclusions are drawn on the options and constraints of vegetation mapping as a monitoring tool for tracking the effectiveness of nature conservation management.

Measuring dark diversity: myth or reality? A comparison of methods within the Czech flora

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Ecological theory and biodiversity conservation have traditionally relied solely on the number of species observed at a site. However, there is consensus that this observed diversity represents only a portion of the actual 'species pool', that is all species in a region that can potentially inhabit those ecological conditions. The species absent from an ecosystem, but belonging to its species pool, constitute the 'dark diversity' of a site. Knowing such dark diversity allows a deeper and more meaningful evaluation of the roles of local and regional processes in ecological communities, including their restoration potential. However, doubts have been raised about the possibilities to actually estimate the dark diversity of a site, which by definition cannot be observed and therefore known precisely. We compared different existing methods to estimate dark diversity, in order to assess how convergent are the results produced by different techniques. For this, we extracted >50,000 relevés from the Czech National Phytosociological Database. Within these samples we selected ~1000 relevés from 18 different vegetation types (phytosociological alliances) and six regions as the specific target of our calculations. Four groups of analytical methods for estimating species pools were compared for the target communities: (a) expert evaluations (Sádlo et al., Preslia 79: 303–321); (b) co-occurrence matrices, i.e. the Beals smoothing approach; (c) species ecological requirements, i.e. using envelopes around the mean Ellenberg indicator values of target communities; and (d) species distribution models, using GIS based environmental niches of species with Biomod. Each of these families of methods can be applied in different configurations. Despite the different nature of the methods results were fairly convergent between them, supporting the idea that estimating the dark diversity is feasible. The differences between methods highlight the number of methodological choices and constraints inherent to each method and indicate that species pools for some vegetation types can be more easily estimated than for others. The main methodological choices within methods involve defining thresholds by which species in a region are allowed, or not, to be included within the species pool. These thresholds are particularly sensible to how frequently species and vegetation types are represented in a region. Threshold definition will also depend on the ecological applications expected from computing species pools. We conclude that no method provides, a priori, a better estimation of species pools but that a combination of methods could provide a robust solution for measuring dark diversities.

Poster E167

INBOVEG, a treasury of vegetation relevés

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Vegetation surveys are important in biodiversity conservation and environmental monitoring. Recently, conservation planning en decision making became more important, resulting in an increased demand for habitat classification (e.g. part of the European Natura2000 network) and an expanding use of databases. Since 2009, the Research Institute for Nature and Forest (INBO, Flanders-Belgium), started developing a new flexible vegetation database. The previously used system had limitations such as the lack of a standardized Flemish Floralist, insufficient quality control, loss of information by changing taxonomy, etc.

INBOVEG is a collection of databases and applications developed to pro¬vide a repository of relevés and make the relevés available for future use. It also provides standardized lists of species, habitats, life forms, scales etc. which are immutable in order to know the values which were available to the recorder at the time of the observation. Original observations are preserved and a full history of subsequent identifications is saved.

INBOVEG supports different types of recordings: BioHab recordings (protocol of Natura 2000 monitoring) and the classic relevés. Both have a common general structure, but BioHab recordings can be brought together and give the description of a landscape. The classic relevés can stand alone, be an element of a collection or element of a chain where the linkage is used to give information about the relative position of recording within a series. In future, extension for e.g. aquatic recordings can be made.

 INBOVEG does not provide any analytical functions. Therefore it has strong selection and export functions towards import formats of other available tools. Relevés can be member of an 'analysis set' or a 'work set'. The first keeps a record of the collection of recordings used for a specific goal. Later research may come back to the same analysis set. The work set is not preserved and is just for exploring data. The database is made accessible by desktop tools such as MS Access. This allows users to create their own queries which is extremely important in a research environment.

INBOVEG is set up as web application what allows an immediate import of data in the field. Consulting the database on line is also possible. Ample selection and export functions toward analysis tools are provided. The first version was launched in 2012 for internal use only. The system will be optimized and extended for external use later this year.

Dissimilarity assessments and the vertical structure of plant communities

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Measurements of community resemblance in plant ecology are often based on species composition and the starting point for calculations is usually a site-by-species data table. However, species composition is not always enough describe plant communities. Characteristics such as size or height of constituent plants are also important for understanding community organization. Thus, resemblance measurements may not be accurate enough when plant communities are described using species composition only. Our aim in this study is to generalize conventional resemblance measurements to incorporate structural data of the community. We first introduce the concept of cumulative abundance profile and explain how to modulate the importance accorded to the plant height, in addition to the usual transformation of species abundance values. We then describe four properties that resemblance coefficients should have in order to appropriately deal with compositional and structural differences. We evaluate eleven distinct dissimilarity coefficients and conclude that appropriate coefficients are the percentage difference (alias Bray-Curtis), Kulczynski and Ružička indices, as well as a new generalization of the Ochiai binary index. We finally present an example of application where we determine the structural and compositional resemblance between Douglas fir forest plots in the Victoria Watershed, British Columbia, Canada. Our approach generalizes the concept of plant community dissimilarity by allowing dissimilarity to be assessed in terms of either structure or species composition, or taking both attributes into account. This generalization has implications on how plant diversity is defined and quantified.

Vegetation dynamics and species coexistence: inspiration from below

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There is increasing interest in explaining species coexistence from the operation of soil biota. The soil biota that roots of species accumulate can be beneficial or antagonistic and may have profound differential effects on plant growth. In this talk I ask the question whether the root responses that we observe to biotic and abiotic factors are consistent with stabilizing mechanisms promoting coexistence. I report a number of experimental results and will attempt to scale them up to expected vegetation dynamics. Next, I will review results on fine-scaled vegetation dynamics from the literature and ask whether the patterns are consistent with results on plant-soil feedback and root responses. I will discuss the discrepancies between these different fields of study and the work required to bridge existing gaps.

Poster A4

Habitat composition of saline grasslands of different landscape-types in Southeast Hungary

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The habitat composition of the Great Hungarian Plain in Southeast Hungary was studied with several habitat-maps made according to Hungary's General National Habitat Classification System (ÁNÉR) in the frame of national habitat-mapping programs (MÉTA) and Natura 2000 surveys. This macroregion includes sand-lands, loess-lands and flood-plains where the saline vegetation with different habitat-composition is connected to typical geomorphological forms. In these landscapes the vegetation pattern was compared with the geographical features especially with genetical soil types, geomorphology and hydrological regime. The aim of the research was to determine the landscape-type specific vegetation compositions of saline grasslands. The saline grasslands of the Dorozsma-Majsaian Sandlands are connected to the southeast parts of the deflation hollows whereas their northwest parts are covered by moor-type vegetation (*Molinia* fens, tussock sedge communities). This twin-characteristic is due to the precipitation-fed regional groundwater-flows which reach the surface at the northwestern part of depressions and flow further towards southeast becoming condensed due to evapotranspiration. A landscape-level gradient was found too indicating that the more saline vegetation types – annual salt pioneer swards and *Puccinellia* swards - appear further from the groundwater-upwelling zones. In the fen dominated depressions just saline meadows appear in smaller coverage. In the loess landscapes (e.g. Kiskunságian Loesslands, Csongrádian Plain) saline habitats are situated in the Pleistocene river-beds (salt swamps, salt meadows, *Puccinellia* and annual salt pioneer swards) and around them on the eroded loess-covered point bars and levées, where the typical salt-berm steppe dominated by *Artemisia* alkali steppes containing micro-patches of salt meadows, *Puccinellia* and annual salt pioneer swards of salt creeks and loess steppe grasslands appears. These habitat-complexes are typical for loess lag-surfaces inserted in the floodplains too which were never flooded before the regulation of river-ways. On low floodplains after the river-regulations two secondary saline habitat-complexes formed. The *Achillea* sub-type is drier and consists of two main habitats. The salt meadows appear in abandoned river-beds, the *Achillea* alkali steppes on levées, while their mosaics cover the point bars. The meadow-steppic sub-type *(Peucedano-Asteretum)* is wetter, situated closer to the active floodplain, but salt-accumulation happens just in the deeper layers. This subtype contains saline meadows and *Achillea* alkali steppes too but the area and patch-number of meadow-steppes are high.

Poster A30

Can alkali associations be predicted based on their elevation? – The use of airborne laser scanning in open landscapes

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Alkali grasslands of the Pannonian Basin are one of the best preserved grasslands in Europe. They are unique as several associations coexist in a very diverse fine-scale mosaic pattern – from short grass steppes (*Artemisio – Festucetum pseudovinae* and *Achilleo – Festucetum pseudovinae*) through open bare alkali swards (*Camphorosmetum annuae*) to alkali meadows (*Agrostio – Beckmannietum eruciformis* and *Agrostio – Alopecuretum pratensis*) and they harbour several endemic species like *Cirsium brachycephalum* or *Suaeda pannonica*. Adjacent to alkali grasslands, on the top of loess plateaus, loess grasslands (*Salvio – Festucetum rupicolae* and *Cynodonti – Poëtum angustifoliae*) are situated. The vegetation pattern of these grasslands is determined by soil salinity and groundwater level. Several studies proved that these environmental parameters show a strong correlation with the fine-scale elevation differences. However, studies on the relationship between elevation and alkali association types are still lacking. There is the still open question: Can topographic elevation models be used to predict association types? High resolution mapping of these associations would be essential for understanding vegetation processes, assessing habitat quality and for designing management plans, but such projects are still missing as landscape-level mapping of this complex structure is often very difficult and time-consuming. The goal of the present study is to provide a novel methodology for large-scale habitat-mapping of alkali landscapes and to predict grassland associations based on elevation data provided by airborne laser scanning (ALS). ALS data with an average point density of 25 points/m² were acquired in March 2012 in Ágota-puszta, Hortobágy National Park (East-Hungary). A high resolution digital terrain model (DTM) with a grid size of 0.25 × 0.25 m was derived from the ALS point cloud. Field vegetation surveys for training and validation purposes were carried out at the same time. 18 plots of 50 × 50 m were designated, representing all typical association types of the study site. Exploratory data analysis (classification tree) was used to study the correlation between elevation and association types. Decision trees were built for association classification. We found that the dominant alliances (*Festucion rupicolae*, *Festucion pseudovinae*, *Puccinellion limosae* and *Beckmannion eruciformis*) could be separated by their vertical position. In many cases, a more detailed distinction was also possible between different associations within the same alliance (like *Agrostio – Alopecuretum pratensis* and *Agrostio – Glycerietum fluitantis*). In other cases we found significant difference in elevation between primary and secondary stands of *Artemisio – Festucetum pseudovinae*.

Poster C91

Spontaneous regeneration of extensively managed lucerne fields – A promising example of grassland recovery of loess grasslands

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Spontaneous succession in lack of restoration-focused case studies is often underappreciated in restoration; however it is a cost-effective alternative method without active intervention. We studied the regeneration of loess grasslands in extensively managed (mown twice a year) lucerne fields using space for time substitutions in Hortobágy, East- Hungary. We addressed the following questions: (i) How effective is lucerne in weed control? (ii) What are the temporal dynamics of the disappearance of lucerne? (iii) How fast is the recovery of grasslands in extensively managed lucerne fields? With the increasing age of fields, the cover of lucerne decreased (from 75.2% to 2.2%), and the cover of perennial graminoids increased (from 0.5 to 50.2%). Mean total cover showed no significant differences between the age groups (mean cover >77% in every age groups). No weed dominated stages were detected during the spontaneous grassland recovery in lucerne fields, the cover of weeds was low (<10%) in all studied age groups. As the age of fields increased, no litter accumulation and no changes of mean total biomass were observed. We found that the recovery of basic loess grassland vegetation is possible within 10 years, but not the complete recovery of the characteristic species pool. We identified several advantages compared to technical reclamation: no early weed dominated stages and litter accumulation was found and only little costs can be expected. However, for the recovery of species rich loess grasslands further management (like propagule transfer by hay and/or extensive grazing) is required.

Are streams the « high-speed corridors » needed by forest plant species to escape the climate change fire?

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Global changes represent an important threat to biodiversity. In the context of climate warming, for instance, it is crucial to maintain ecological connections in our contemporaneous fragmented landscapes to allow species to migrate towards more suitable environments. The conservation or even restoration of ecological corridors is among the most important conservation strategies worldwide, but their effectiveness still remains an open question. Metacommunity ecology provides a useful framework to answer this question but so far relatively few studies have concerned plant species.

In this study, we evaluate the connectivity effect of small streams originating in a large ancient forest for plant communities of forest patches within an agricultural landscape. We compared α- and β-diversity of patches connected to a large forest with isolated patches, while controlling for habitat effects, patch area and patch age. Between-patch distances were calculated using a GIS (ArcGIS®, ESRI Inc.). Patch age was deducted from historical maps and aerial photographs from 1760, 1826, 1939 and 1963. Species composition of each patch type was examined with a non-parametric MANOVA and an Indicator Species Analysis.

Forest patches connected to the main forest through streams were not more species-rich after accounting for habitat effects but were more similar than isolated patches, be the latter crossed or not by a stream. Also, connected patches exhibited a different species composition with more forest habitat specialists and more hydrochores than non-connected patches. Many forest herb species well known for being dispersal-limited appeared to be efficiently transported by water as incidental hydrochores over long distances and relatively short time scales. Using streams as "high-speed corridors", these species increased their colonization speed of at least 15 times compared to conventional dispersal.

This study clearly evidences that streams can act as efficient corridors for plant species across agricultural landscapes and contribute to the dynamics of forest metacommunities. From a management perspective, preserving the longitudinal integrity of streams likely increases the connectivity within and between forest metacommunities and can assist dispersal-limited species to tackle the climate warming challenge by increasing their migration speed.

Poster D117

Floral food-bodies and a bellows-like mechanism in bird-pollinated *Axinaea* (*Melastomataceae*)

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Pollen as the only reward for bee pollinators is characteristic for most Neotropical *Melastomataceae*. For eight genera belonging to four different tribes, however, nectar secretion and both vertebrate and invertebrate pollinators have been reported. The flowers of the mainly Andean genus, *Axinaea* (*Merianieae*), are characterized by distinctive bulbous anther connective appendages. It has been hypothesized that these appendages play a key role during pollination and serve as food-bodies to attract pollinators other than bees. To test this hypothesis, we conducted field studies in southern Ecuador, and investigated floral structure in detail using micro-computed tomography (microCT) and other methods. We found that the flowers are not nectariferous and that they attract various species of Tanagers (*Thraupidae*) that consume the brightly coloured bulbous appendages. In addition to their function as a food reward, the anther appendages are also an integral part of a complex bellows pollination mechanism. The bellows is activated when a bird squeezes the appendage with its beak in order to remove the stamen from the flower. This action results in a cloud of pollen being expelled from the terminal pore of the anther and landing on the bird's beak and head. Accidental contact with the stigma effectively transfers pollen during floral visits. Usually, an anthetic flower is visited two to three times before all anthers are removed. The resulting seed set is high. As Tanagers were the only observed visitors capable of activating this mechanism, they can be recognized as the legitimate pollinators. The evolution of the bulbous connective appendages in *Axinaea* may serve as another example of a shift in pollination syndromes correlated with growth at higher elevations where bees are less efficient pollinators than birds.

The impact of livestock grazing on plant diversity in drylands: an analysis across biomes and scales in southern Africa

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A general understanding of grazing effects on plant diversity in drylands is still missing, despite an extensive theoretical background. Cross-biome syntheses are hindered by the fact that the outcomes of disturbance studies are strongly affected by the choice of diversity measures and the spatial and temporal scales of measurements. The aim of this study is to overcome this weakness by applying a wide range of diversity measures to a data set derived from identical sampling in three distinct ecosystems over five consecutive years. In doing so, we also want to contribute to recent discussions in disturbance ecology. We compared three fence-line contrasts (high vs. low grazing intensity) along bioclimatic gradients from arid to semi-arid and from summer to winter rainfall in southern Africa. We tested the impact of heavy grazing on multiple aspects of plant diversity (richness and evenness components, alpha and beta diversity, composition) at different spatial scales, and compared the responses in terms of species and plant functional groups. Higher land-use intensity reduced total plant cover and substantially altered the species and functional composition consistently across the climatic gradient. However, a significant decrease in species alpha diversity was detected only in one of the three sites. By contrast, alpha diversity of plant functional groups responded highly consistently across ecosystems and scales with a significant decrease at higher grazing pressure. Functional richness responded less sensitively and less consistently than functional evenness. Beta diversity of species and functional types increased under heavy grazing, showing that at larger scales the heterogeneity of the community composition and the functional structure was increased. Our results suggest that species diversity alone may not adequately reflect the real dimension of community shifts that occur in response to increased land-use intensity in the dryland biomes of southern Africa. Changes are better reflected by trait-based diversity measures. In particular, measures of plant functional diversity that include evenness represent a promising tool to detect and quantify disturbance effects on ecosystems, with significant benefits for environmental conservation and management.

Ecology of highest growing vascular plants in NW Hiamalayas

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Due to the dry continental climate, the gentle slopes and plateau of Ladakh (Little Tibet) in NW Himalayas are free of glaciers and permanent snow-fields up to 6200-6400 m. Ladakh belongs to the regions on earth with the highest recorded and predicted temperature increases, while presently sustaining a substantial alpine and subnival flora, which includes some vascular plant species that ascend to near the highest elevation (6160 m) on record. In our long-term research project, we tried to answer the following questions: (1) Do vascular plants migrate toward higher elevations due to warming? (2) Which factors limit the upward migration of plants? (3) In particular, what is the role of plant ecophysiology, presence of diaspores and suitable habitats? (4) Is the upward migration enhanced or suppressed by interactions between the plants? To answer these questions we focused on (1) direct monitoring of vegetation using system of permanent plots, (2) species-specific analyses of stored carbohydrates, water and nutrient status of plants, (3) herbochronology as a tool to age the plants and assessed their growth histories, (4) the role of competition and positive interactions between plants, and (5) the diversity of soil cyanobacterial and microalgal communities as first colonizers of high-mountain soils affecting nutrient availability for vascular plants. In addition, results obtained from transplantation experiments proved instrumental for parsing the respective roles of specific habitat or dispersal limitations as individual components of overall vegetation changes.

Relationship between an invasive grass and a grassland vegetation community in southern Brazil

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Invasive species are considered to potentially have strong effects on native biodiversity and processes that maintain it, however the way invasive species act and the range of impacts provoked by them often are poorly known. This work aimed to identify the effects of *Eragrostis plana* Nees, a highly invasive cespitose C4 grass from Africa, on grassland communities in subtropical southern Brazil. Our data collection was conducted in three sites in Rio Grande do Sul state (Pampa biome), Brazil, with forty 1 × 1 m plots per site, situated in native pastures. Plots were allocated in a stratified fashion in order to encompass a gradient of E. plana cover. In each plot, we evaluated the identity and cover of all herbaceous plants. We found that, despite being located more than 300 km from each other and having different floras (ANOSIM, p = <0.001) and grazing pressure history, all areas showed a negative relationship between cover of the exotic species and species richness (average R^2 = 0.28, standard deviation = 9.41, p = <0.001). This pattern was found when all sites were accounted (sites been used as covariate in a permutation linear model, R^2 = 0.3, p = <0.001). We used the species cover matrix to split the influence of E. plana cover and site in a stratified PERMANOVA, and likewise found a clear pattern. Our results point out to a negative impact of E. plana cover on plant richness at a local scale, in different regions of RS. The studies grassland communities are species rich (mean species number per plot, over all levels of invasion: 29; total number of species in all plots: ~350), and invasion by E. plana, as observed throughout the Pampa biome, may significantly reduce this species richness. Our next step will be to evaluate the impact of E. plana on different plant functional types and on rare and common species, as well as to increase the number of sites of our study in to increase our knowledge of E. plana influence over native grasslands in southern Brazil.

Poster D129

Forest development after stand-replacing wind disturbance in the hemi-boreal zone of north-eastern Europe, Estonia: the importance of advance regeneration

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Heterogeneity in the forest landscape, regarding stand structure and development stage, provides a wide range of opportunities for species to establish, and hence to increase ecosystem biodiversity. This heterogeneity is maintained by disturbances and natural processes. In the hemi-boreal region in north-eastern Europe wind disturbance plays a key role.

During their evolution, tree species have developed different life-history traits. The potential of a shade-tolerant species to maintain itself as advance regeneration in the understory and to develop into the canopy after release, has been acknowledged. Other research shows that new regeneration, linked to the occurrence of disturbance-created microsites, dominates forest development after disturbance. This study investigates the performance of advance regeneration in forest development after large-scale windthrow and its ability to compete with newly establishing regeneration. We hypothesise that smaller-sized advance regeneration, in higher abundances in the understory of old growth forest, have an increased probability to survive windthrow and will respond adequately to release. As a result it will have an advanced competitive position compared to newly establishing regeneration and plays an important role in the development of the future tree canopy composition. We assessed advance regeneration tree species, age, height and diameter increment, vitality and competition in 21 forest stands of comparable forest site type and in different stand development stages.

Preliminary results show that advance regeneration in old growth forests consist for 78% of spruce (*Picea abies*) and 14% of lime trees (*Tilia cordata*). Therefore shade tolerant species dominate the understory. The majority of spruce advance regeneration are distributed over the lower height classes (up to 2.00 m). Vitality classes of spruce compared with birch (*Betula* spp.) advance regeneration show no clear difference, however spruce is able to maintain itself in less favourable canopy positions. Birch advance regeneration is younger in all height classes.

After windthrow abundant advance regeneration, mainly shade tolerant spruce from the lower height classes, survives.

Further results demonstrate that all encountered tree species, including shade-intolerant, show considerable height increment in the first years after release. Newly established regeneration mainly germinates on windthrow-created microsites. However undisturbed forest floor, with intact vegetation layer, covers up to 85% of the area in all wind-induced forest stands.

10 years after windthrow, birch and spruce are dominating tree species. The majority of trees on intact soil consists of released advance regeneration.

A test of the relationships between climate, net primary productivity and biomass quality at the regional scale

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Despite numerous studies, it is not clear that the amount and the quality of biomass production across regional environmental gradients are linked in a consistent way across regions and ecosystem types. Considering the effect of climatic variables structuring ANPP of ecosystems, and its influence as a filter for the establishment of plant species with certain leaf attributes, we analysed how ANPP and plant quality vary along a climatic (mostly precipitation) gradient of Central-western Argentina. We predicted an increase in ANPP as precipitation increases along the gradient, as well as a replacement from conservative (lower leaf quality) to acquisitive (higher quality) dominant plant species from ecosystem with lower ANPP to those with higher ANPP. We sampled 9 ecosystems, including arid shrublands, grasslands, dry forests and savannas. Within each ecosystem we established 20 plots, in which we selected the 10 most abundant plant species, estimated their relative cover, and measured 7 leaf traits on them, as indicators of biomass quality: content of carbon (C), nitrogen (N), and phosphorous (P), C:N and N:P ratios, leaf tensile strength (LTS) and specific leaf area (SLA) to calculate weighted means for each trait. We estimated ANPP based on MODIS satellite imagery. In agreement to our prediction, N (in woody ecosystems only), P and SLA increased from low to high ANPP ecosystems. Grasslands showed a significantly lower value of N than woody ecosystems. On the other hand, C:N ratio decreased with PPNA only for woody ecosystems. LTS showed no clear trend. The dominant plant growth forms (graminoids, forbs, shrubs and trees) strongly determined the prevalence of certain attributes at the different sites, as reflected in the comparison between grassland and woody ecosystems. The dominance of certain functional attributes, and therefore green biomass quality, was determined in a nested way by both precipitation and the associated ANPP, as well as by the dominant plant functional types.

Altered fire regimes and demographic responses combine to threaten plant species persistence as climate warms

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Altered disturbance regimes are a manifestation of warming and drying climate across much of the Earth's surface. Fire acts as a filter in determining the persistence of plant species via the intersection of fire frequency and species demography. A warming and drying climate will synergistically impact plant species by simultaneously shortening fire intervals and reducing survival, growth and reproduction. Mediterranean regions of the world are among the most vulnerable to this synergism given their fire-prone nature and high level of anthropogenic impacts. We present evidence of fire – climate interactive effects on plant species resilience based on field experimental data from south-western Australia, a Mediterranean-type region with a strong signal of recent precipitation and temperature change. Further, we develop a conceptual model (the interval squeeze model) broadly applicable to fire-prone regions with crown-fire regimes. Interval squeeze will narrow the window of overlap between the fire interval and plant demographic envelopes compatible with stand replacement for many species, leading to greatly elevated extinction risk. Based on this model and its predictions, new approaches to fire regime management are needed which will maximise the in situ adaptive capacity of species to climate and fire regime change.

Long-term grazing exclosures alter beta diversity in alpine meadows primarily through effects on alpha diversity

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Beta diversity patterns are increasingly being investigated to gain insights into the importance of stochastic relative to deterministic processes governing community assembly. Although numerous correlative studies have yielded important and sometimes surprising discoveries, experiments provide the opportunity to better identify underlying causal processes. We took advantage of long-term (>15 years) grazing exclosures, located at two alpine sites in southern British Columbia (separated by 160 km) that exhibit contrasting productivity, to address the following questions: (i) how does grazing affect alpha and beta diversity within alpine meadows, (ii) how does the effect of grazing on beta diversity vary across the two sites of contrasting productivity, and (iii) how does grazing change the importance of stochastic relative to deterministic community assembly? We addressed these questions using null models that enable comparisons of observed beta diversity patterns to those that are expected based upon stochastic (random) sampling of species from the regional species pool.

Grazing affected both alpha and beta diversity in different ways at each of the sites. In general, it significantly reduced alpha diversity at the lower productivity (more stressed) site, but had marginally positive effects on alpha diversity at the higher productivity (more mesic) site. Grazing had inconsistent effects on raw beta diversity (Jaccard index) at each site, with a trend towards a positive influence at the low productivity site and a negative influence at the high productivity site. However, the null model results indicate that these effects were largely due to due differences in alpha diversity. We conclude that (i) the effect of grazing on both alpha and beta diversity depends in part upon the productivity of the system, and (ii) that much of the influence that grazing has on beta diversity is due to its effect on alpha diversity.

Species pools in cultural landscapes: Niche construction, ecological opportunity and niche shifts

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Many species are associated with habitats that occur in cultural landscapes, i.e. landscapes that are largely formed by the impact of human management. In NW Europe this is particularly obvious for habitats that were formed during the transformation of the previous, mostly forested, landscapes, to more open landscapes with pastures, meadows and fields, a process that was initiated during the Neolithic and has continued to the last centuries. Many of the habitats that are interpreted as remnants of the "old-fashioned" grazing and mowing management are conspicuously species-rich. A long standing question has been where (geographically and ecologically) the species pool associated with these open or semi-open habitats occurred before this large-scale transformation. A common idea is that analogs to the habitats in the cultural landscape occurred already before the landscape transformation, and that species thus have maintained their niches. This represents niche conservatism, the idea that species maintain their realized niches when subjected to environmental change, an idea that is also a dominating view in efforts to predict future changes in species distributions. However, evolutionary shifts in niche relationships are well-known, and there is evidence that species may alter their realized niche also in a shorter time-scale. I discuss whether species may alter their niche relationships as a result of ongoing transformation of plant communities, due to species redistribution, climate and land use change. Niche construction is the process by which species may create niche space for themselves and for other species. I suggest a conceptual model for how human-mediated niche-construction creates ecological opportunity for niche shifts, thus affecting the build-up of species pools in cultural landscapes. The basic components of this niche-construction process driven my human management are increased openness, habitat connectivity and spatial stability of habitats. These components can all be related to population processes and to potential niche shifts. My focus is on historical landscapes and the landscape transformation that took place from the Neolithic and onwards, but I will also discuss whether this model may be applied to current development of novel plant communities.

Diversity and distribution of resource plants in mountainous villages of Japan: focusing on provisioning of various ecosystem services

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Not only overuse but also underuse of natural resources can cause significant losses of biodiversity especially in semi-natural agricultural ecosystems. People's natural resource management can determine diversity and distributions of resource plants in landscapes. To evaluate overall contributions of resource plants to regional species diversity, we compared diversity and distributions of these species with those of total plant species among various landscape components in mountainous villages of Japan. We classified resource use types into four categories of provisioning services: food, medicine, materials and fuel. In total, 422 species were recorded at 140 sites. Among them, 74 species (including 32 woody species) were listed in at least one of the resource use categories. The numbers of resource plants for food, medicine, materials, and fuel were 35, 38, 21, and 5 species, respectively. Proportions of food and medicinal species were significantly positively correlated with total species richness, while those of material and fuel species showed negative correlations. Both richness and appearance frequency of resource plants were lower in private gardens and surroundings of paddies and crop fields, whereas those in the slopes along conduits and farm roads were higher compared to other landscape components. Secondary woodlands had higher potential to provide fuels and some material species, although overall species diversity was lower compared to the other landscape components. Our results suggest that diversity and distribution of plants used for food and medicine can be good indicators of regional semi-natural grassland biodiversity in agricultural landscapes. Extensively managed landscape components, such as slopes along the conduits and farm roads, still sustain populations of resource plants, and these species can represent overall species diversity within the communities. Although both resource plant species and their associated species in semi-natural habitats have been maintained by appropriate management practices, ongoing depopulation and abandonment of natural resource uses could pose further threats to future species diversity in mountainous villages of Japan through the loss of traditional ecological knowledge.

Ditches as corridors for plant communities in intensive agricultural landscapes

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Due to agricultural intensification, linear landscape elements (LLE) such as hedgerows, grassy strips or ditches often remain the only available habitats in agricultural areas, and may promote species dispersal in the landscape. Contrarily to semi-natural areas, that are often very isolated, LLE generally constitute a network of green veinings within the landscape.

Among LLE, ditches often represent the only remnant habitat for wetland plants in drained lowlands, and may represent potential corridors for species dispersal. However, many elements (culverts, concrete plates, bank management...) may affect the connectivity of these artificialized ditch networks, and thus the actual dispersal of plant species.

This study aims at evaluating the relative roles of adjacent landscape and connectivity of a dense ditch network on ditch bank plant communities in northern France. We selected thirty 500×500 landscapes based on a double gradient of percentage of seminatural habitat and density of ditch network. Floristic releves were realised in nine ditch banks per landscape, leading to a total of 270 ditch banks. Community richness, composition and similarity were analyzed at the landscape and ditch scales. Landscape composition, configuration and ditch network connectivity metrics were calculated from GIS landcover and water system maps.

We tested the following hypothesis: 1.) A better connectivity of the ditch network impacts ditch plant community structure through propagule dispersal along water; 2.) Landscape heterogeneity may also influence communities structure by impacting the amount and quality of propagule sources, and their connectivity. We demonstrated that at the landscape scale, community richness is driven by the amount, quality and connectivity of ditches, but also by landscape heterogeneity. A high amount of culverts reduces species richness, probably because of their barrier effect on plant dispersal through hydrochory. Landscape heterogeneity, that may provide more diverse habitats for plant species, enhance the diversity of available seed sources and seems to have a positive effect on ditch plant communities species richness.

This work suggests that beyond the local management of the banks, spatial arrangement of LLE within the landscape may impact plant communities structure. These results will provide some clues for the integration in landscape planning of the current agri-environmental policy concerning blue and green infrastructures. Improvement of ditch plant communities richness may thus rely on appropriate management of the banks, but also on landscape structure and in particular on the connectivity of ditches.

Towards a hybrid vegetation map for local conservation planning

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Patterns of spontaneous vegetation are fuzzy. This fuzziness has always been a challenge for remote sensing scientists and has boosted the development of various approaches for discrete, fuzzy and continuous vegetation mapping. Conservation planning, for example in the context of the European Habitat Directive, requires information that can hardly be taken from a single map. On the one hand, the local distribution of habitat types is required in discrete fields. On the other hand, the condition of these types needs to be assessed from quantitative information on their species composition. Our study thus aims to develop a mapping approach that is able to provide this information in a concise, comprehensive and explicit way as a hybrid map.

The study was carried out in a complex of raised bogs, poor fens, sedge wetlands and wet meadows in Southern Germany. We sampled the vegetation in 60 plots during a field campaign in summer 2011. For each plot, we assessed the cover fractions of all occurring vascular plants and dominant mosses. In addition, we classified the plots according to the habitat classification key of the European Habitat Directive. The vegetation records were subjected to Nonmetric Multidimensional Scaling (NMS) to extract the main gradient in species composition across all plots. This gradient (the first NMS axis after principle component rotation) explained 56% of the original floristic variance.

A hyperspectral image was taken with the airborne sensor AISA dual simultaneous to the field campaign. This image provided information on the surface reflectance in 367 spectral bands with a 2 m spatial resolution on the ground. We extracted the plot reflectance from the imagery. Random Forest classification and regression was used to relate the vegetation properties (habitat type and position on the NMS axis) to the corresponding reflectance data. The models resulted in an overall accuracy of 61% for the assessment of habitat types and a $R^2=0.74$ for the modelling of NMS scores. Both models were applied onto the image to derive a hybrid map showing the discrete habitat types as shading over a continuous map displaying the floristic gradient. This map enables an easy assessment of habitat distributions and conditions at local scales.

Diversity relationships between vegetation and modern pollen samples in the Setesdal valley of south-central Norway

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Pollen has been an important proxy for studies of past vegetation history, but challenges related to pollen data has limited the use of these studies for investigating past biodiversity. Here we want to present our project where we by studying modern pollen – plant diversity relationship are attempting to correct for biases in pollen samples and provide a method for estimating more reliable pollen diversity estimates that can be applied on fossil data.

We provide an example from the Setesdal valley in south-central Norway. This valley runs along an altitudinal gradient, covering six major vegetation types from the low-alpine region, through the sub-alpine, northern boreal, mid-boreal, southern boreal, to the boreonemoral region in the south. We have pollen data from surface sediments and vegetation data from the catchment of 52 lakes. Hill's family of Rényi indices (N0, N1, and N2) was used to estimate diversity on untransformed and transformed pollen counts using Andersen's general representation values.

Our results show that there is a positive, but statistically non-significant, correlation between the relevant pollen types of the plant species and the actual pollen/spore types using untransformed pollen counts. However, this changes after transforming the pollen counts and the correlations show statistically significant relationships for all Hill's numbers, and indicate that transforming raw pollen counts helps to reveal diversity relationship between present-day vegetation and modern pollen assemblages. These results are promising, and may imply that correction factors should be used when estimating terrestrial biodiversity from long-term pollen records. However, more analyses are needed to establish this with confidence.

Monitoring the effectiveness of habitat conservation in Switzerland

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The habitats of national importance are a crucial element of the Swiss protected sites network. It is important to know if the conservation values of these habitats are maintained. The project «Monitoring the effectiveness of habitat conservation in Switzerland» is a long-term monitoring study initiated by the Federal Office for the Environment FOEN. Specifically, the project will inform about trends in the area and the quality of dry meadows and pastures, riparian areas, bogs and fens and amphibian breeding sites of national importance. For this we study all objects (about 6000 objects) of national importance of these four habitat types by remote sensing, which delivers data on processes such as bush encroachment, erosion, habitat dynamics or human interventions such as roads. In dry meadows and pastures, alluvial areas, bogs and fens, we additionally collect vegetation data in the field. We select a stratified random sample of more than 800 objects belonging to one of these habitat types. Within each object between five and 15 plots are randomly selected according to a complex procedure taking into account auxiliary information such as the spatial distribution of rare vegetation types and the size of the objects. In the field, plots are permanently marked with magnets (below-ground) and their exact position is measured by GPS. On each plot (10 m^2), we generate a full species list of vascular plants as well as bryophytes in fens, bogs and alluvial areas. We thus do not record vegetation types directly, because this would strongly reduce the possibilities for future analyses. It is important for a long term monitoring to get data with as few constraints as possible so that they enable a range of analyses and thus the possibility to be also used for newly emerging questions (e.g. due to new priorities in environmental policy). Full species lists allow a large variety of analyses (e.g. indicator values, population trends, species richness) as well as drawing inference on main processes and their causes (e.g. eutrophication, intensification or abandonment of management, climate change). At the randomly selected amphibian breeding sites, we collect data on amphibian presence/absence of adults, larvae and spawn.

The project's results will serve as an early-warning system on the national level as well as the main biogeographical regions of Switzerland, i.e. trends within these regions will be recognized early on, thus enabling adaptations in conservation measures.

Optimal atributes for remote detection of giant reed in riparian habitats

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The giant reed or cane (Arundo donax L.) is an aggressive invader species responsible for biodiversity loss and failure of many riparian ecosystem functions. Traditionally, giant reed invasions have been identified by field surveys or by photointerpretation. However, remote sensing techniques have the advantage of covering large areas with the possibility of using semi-automated and repeatable procedures that are less subjective and less time consuming.

In this work, we used object-based image analysis to map giant reed invasions in an extension of 2.5 km of a Tagus River tributary. The units of the object-based classification - objects - are composed by groups of adjacent pixels that correspond to real-world entities. Giant reed objects can therefore be described using spectral information, but also spatial (size, shape configuration, stretching level) and textural (statistical arrangement of pixels) metrics.

Machine learning techniques (bagging decision trees) were used to select the optimal attributes for the image classification of giant reed objects. Classification accuracy was performed using landscape metrics and the Kappa coefficient to compare the geographical location and the total area of the giant reed patches obtained with the object-based map and with a validation map derived from on-screen digitizing. The methodology was tested in two images with different combinations of spectral and spatial resolution: an airborne multispectral imagery, with four bands and 50cm of pixel size, and a satellite image, WorldView2, with eight bands and 2 m of pixel size.

Results showed that Normalized Difference Vegetation Index (NDVI) and the spectral reflectance values in the red and near infrared region, combined with the size and the stretching metrics were the most important attributes to distinguish giant reed from the non-giant reed objects. We observed that giant reed patches display simultaneously, large and elongated patches with very high greenness level, which allows a clear distinction from the non-giant reed objects. The satellite image WorldView2 showed higher mapping accuracy (Kappa coefficient of 77%), although it overestimates the total invaded area due to the lower spatial resolution compared with the airborne images. On the other hand, airborne images were more accurate in detecting the degree of invasion, due to high spatial detail that can be obtained. However, in highly heterogeneous landscapes, the low spectral resolution of these images (4 bands instead of the 8 of WorldView2) reduces the capability to detect giant reed patches.

Poster E170

Studying forage quality and quantity of West African rangelands in the context of climate change

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Climate change will likely have severe influences on rainfall pattern and thus on the whole ecosystem's productivity in African savanna regions. Changing rainfall pattern will likely alter timing and duration of the growth period, which will in turn have severe effects on rangelands' ecology in general and the ecosystem service of forage provision in particular. Grazing systems are among the most important components of land use systems in West Africa.

This work is part of the international and interdisciplinary research program WASCAL which aims at helping ten West African countries to enhance the resilience of human and environmental systems to climate change. We aim at deriving spatial information about the quality and quantity of forage. Forage value and provision are used as indicators of good and bad practice in rangeland management under a given climate. This spatial information will be gained using remote sensing techniques.

The specific objectives addressed in this research project are as follows:

1. Estimating rangeland quality and quantity in West African savanna regions using reflectance data

2. Detecting forage characteristics of different rangeland types in West Africa along a climatic gradient
3. Interpretation of large-scale spatial patterns of forage characteristics found by remote sensing

Our study area is situated along a climatic gradient of increasing aridity going from Northern Ghana to centre Burkina Faso. Within this zone, sites corresponding to different types of grazing lands are investigated to collect data on reflectance properties as well as forage value, biomass, and the floristic composition. The spectrometric measurements are taken with two different spectroradiometers which detect full-range and half-range spectra, respectively. Data are used to calibrate regression models that describe the relationship between reflectance features and rangeland characteristics (forage quality and quantity). The application of the regression models on remote sensing data enables an investigation of rangeland states on a wide spatial and temporal scale that can be related to land-use practices. First results indicate that both full-range and half-range spectra can be successfully used to calibrate regression models with a high explanatory power regarding forage characteristics. By making use of these models, a fast and non-destructive monitoring of rangeland states in West African savannas can be implemented. We hope that this approach can contribute to the identification of sustainable land use practices under a range of different climatic conditions.

Differences in the spatial structure of the primary and secondary tropical rain forests

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Plants are affected mostly by biotic interactions and abiotic conditions in their immediate neighbourhood and these local processes shape the spatial structure of plant communities. Therefore, spatial patterns can be used to infer past processes. The regular patterns are considered a result of competition of neighbouring individuals. Processes forming the aggregated patterns include environmental heterogeneity, dispersal and facilitation, but their effects are difficult to distinguish. Newly introduced methods of analysis of marked point spatial pattern enable better insight into individual spatial pattern forming processes.

We analyzed spatial structure of two closely located one hectare lowland forest plots in Papua New Guinea. The first plot represents the primary forest; the second a 10 years old stage of secondary succession in abandoned "garden" in the shifting agriculture system. All trees with diameter at breast height (dbh) ≥5 cm were characterized by their species identity, location, dbh, and height. Spatial patterns of plants were studied by spatial pair and mark correlation functions and spatial diversity measures to distinguish their overall, inter and intra specific associations; observed patterns were always compared with various null models to distinguish various pattern generating mechanisms.

The number of individuals was similar in both plots, but the primary plot had higher number of species and also higher number of singletons (species represented by a single individual). In the primary plot, random spatial pattern prevailed (overall and the individuals of the most common species), whereas aggregated spatial patterns (at various spatial scales) were common in the secondary plot. No spatial associations of other species to the individuals of the most common species were found in either of the plots. Conspecific aggregations were rather common in the secondary plot. In the secondary plot, local species richness and diversity were lower than expected under the random distribution of species; in the primary plot it followed the random model expectation. Aggregations of individuals differing in dbh were found in the secondary plot, no similar structure was found in the primary plot.

The possible mechanisms generating individual patterns will be discussed. We hypothesize, that the prevailing effects of dispersal and establishment processes caused the aggregations in the secondary plot. Further, we expect that the intensive inter-species interactions compensated for these effects in the primary plot, which finally led to near random patterns; however, we cannot exclude the possibility that non-randomness in species rich primary forest would be detectable only on larger spatial scales.

Determinants of community resilience to fire in tropical and subtropical grasslands

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Grassland ecosystems dominate large areas around the world, being influenced by disturbance regimes. In Brazil, fire is an important disturbance event, affecting the dynamics and diversity of both tropical and subtropical grasslands. Still, grassland ecosystems in Brazil, which are rich in plant species, are usually neglected by environmental agencies and thus, threatened by changes in natural disturbance regimes such as exclusion from fire, leading to changes in vegetation diversity and structure. We hypothesize that both tropical and subtropical grasslands are resilient to fire and that species richness, vegetation structure and cover can influence the resilience of these ecosystems. We analysed plots in tropical (30) and subtropical grasslands (12) before and one year after fire experiments. We carried out vegetation surveys and sampled biomass in both ecosystems. We considered resilience as the ability and speed taken to recover from a disturbance event. As a measure of resilience, we used Chord distance, calculated based on plots species composition and cover, before and after disturbance. We conducted model selection analysis for 12 models created a priori, in which resilience could be explained by the following variables: total species or forbs species richness; plot coverage by all species, by forbs, graminoids, shrubs or dead biomass; total or graminoid biomass; and three models with variables interactions. Both tropical and subtropical grasslands showed to be resilient to fire, recovering very fast after prescribed burns. Our results showed that, in subtropical grasslands, the total species richness was the best model explaining resilience and all other models had ΔAICc>8.5. However, we did not find the same results for tropical grasslands. Graminoid cover had the lowest ΔAICc, but other models, including the null model, had ΔAICc<2. Thus, in tropical grasslands, more studies should be conducted to investigate which factors affect grasslands resilience, whilst the total species richness was the best model to explain resilience in subtropical grasslands.

Assessing areas of potential conflict between laurel forests and alien tree invaders at Madeira Island

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Laurel forest communities extant at Madeira Island are characterized by high floristic diversity, presenting a significant proportion of endemic species. The invasion of their potential areas of distribution by tree exotic species perform a significant loss of biodiversity, based on the assumption that the recover of the native communities will reach the same level of diversity described. Such theoretical loss of floristic diversity is expected to be especially significant on areas potentially related to the temperate and the mediterranean laurel forests, once communities dominated by alien species present significant lower plant diversity. This study aims to identify the areas of potential conflict between such native forests (temperate laurel forest: *Clethro arboreae-Ocoteetum foetentis*; mediterranean laurel forest: *Semele androgynae-Apollonietum barbujanae*) and alien tree species capable to install floristically poor and structurally dense communities (*Pittosporum undulattum* Vent., *Acacia mearnsii* De. Wild., *Acacia melanoxylon* R. Br.). Assessment is supported on niche-based models of correlative nature. During a first stage, models are produced for the species level, based on an ensemble forecasting procedure supported on different modelling techniques and calibration parameters in BIOMOD platform. In order to assess the potential distribution of the native forests, models of selected species where combined on a single model, assigning different scores to each species. For species selection procedures we considered tree species that are accepted as characteristic or having a structural importance for the community according to surveys supported on a fitosociological perspective. For the exotic species, only trees with capacity to establish stands spontaneously and with significant distribution on the island are considered. In terms of results, the higher level of conflict is identified for the Mediterranean laurel forest, a result determined by the availability of area abandoned by agriculture and suitable to invasion by *Acacia mearnsii*. In the case of the temperate laurel forest, the potential conflict is considerably lower, a result determined by the existence of considerable areas yet occupied by such forest. Considering alien species, the higher conflict of such native forest is identified for *Acacia melanoxylon*, which indicates the existence of a distinction between the type of native forest and the alien species with higher level of potential conflict.

In search of response and effect traits in grassland plant communities under different grazing intensities

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Livestock grazing on natural grasslands is an important driver affecting plant functional traits, which in turn may affect litter decomposition, for plant traits may mediate litter breakdown and detritivore invertebrate activity by determining habitat architecture. Here we assess how grazing intensity (GI) affected plant functional traits, and how these shifts affect litter decomposition (LD) and detritivore activity (DA). We also identify traits that better represent these responses and effects. We collected data from a long-term grazing experiment established in natural grassland in southern Brazil (30°06'00"S, 51°40'55"W). The area (52 ha) was divided in 14 experimental units (paddocks) and subjected to different treatments of grazing intensity since 1986. In each paddock we recorded average plant species cover and their functional traits, LD (litter-bag) and DA (bait-lamina). We used trait selection analysis to identify which traits maximized trait-convergence and trait-divergence related to GI (response), LD and DA (effect). We calculated functional diversity (Rao entropy) of each paddock based on the trait subset selected for divergence for GI (FDGI), LD (FDLD) and DA (FDDA). We tested the effect of GI on response traits and FDGI by analysis of variance. We also tested the influence of traits and FDLD and FDDA on LD and DA by linear regression. Traits that expressed convergence in response to GI were SLA (increased), and LDMC, presence of caespitose, hemicryptophytes and C4 species (all decreased). Also, FDGI and FDDA decreased, while FDLD had greater values with intermediate intensity. Traits that expressed convergence related to LD and DA were presence of C4 species (increased) and plants with underground storage organs (increased), respectively. DA was greater at low FDDA and LD was greater at high FDLD. Grazing acted as an environmental filter. Under high grazing intensity, severe defoliation allow only species adapted to rapid resprout. Under low grazing intensity, the reduction of defoliation enables species with high investment on strong and long-lived leaves. Furthermore, competition in these plots promotes niche differentiation and a high functional diversity (FDGI). Detritivore organisms benefit from the dense vegetation habitat formed in these areas. Litter decomposition was likely favored by open canopy vegetation (high investment to underground organs), which may have increased photodegradation. Functional plant diversity (FDLD) could be a proxy of microbial diversity, affecting LD. Causal relations between traits and decomposition are difficult to disentangle, requiring further confirmatory path analysis and structural equation modelling.

Poster D101

Demographic differential response of two shade-tolerant tree species to successional stage and size of Atlantic forest fragments

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The demographic response of plants to environmental heterogeneity caused by a disturbance is a key issue in population ecology. In the tropics, fragmentation and subsequent secondary succession are among the largest sources of disturbance. In an Atlantic forest fragmented landscape we investigated how population dynamics of two tree species that differ in the degree of shade tolerance are affected by size and successional stage of forest fragments. We tested if the population dynamics of the understory species (*Rudgea jasminoides* (Cham.) Müll.Arg.) was positively affected by fragment size, as indicated by its density and population structure. For the canopy species (*Guapira opposite* (Vell.) Reitz) we tested if its population dynamics was favored by fragments in early successional stages and was stable in the late successional ones, as expected by its light availability preferences. The study was conducted in six secondary forest fragments classified into two sizes (small or large) and into two successional stages (early or late), where we marked in 0.5 ha plots all individuals belonging to these species and followed them for two years (2007-2009). Depending on species, the data were pooled according to size or successional stage and were applied matrix models (linear and deterministic) to calculate the asymptotic population growth rate (lambda - λ) and to perform perturbation analysis (elasticities). Contrary to our expectations, the population growth rate of the understory species indicate that its population is growing in small fragments (between 1.2 and 1.7% per year) and is stable ($\lambda \approx 1$) in the large ones. This difference among the lambdas causes that the duplication time of the population in small fragments is 4.5 times greater than in large fragments. Fertility and growth vital rates were greater in small fragments, which were confirmed by perturbation analysis. To the canopy species, the population growth rates did not differed among the two successional stages considered, so that both populations are stable ($\lambda \approx 1$), although there were differences in vital rates. To both species, the conclusions are optimistic from the conservation point of view, as the canopy species seems well adapted to fragmented landscapes and the presumed risk of local extinction of the understory species in small fragments may be retarded or even reversed with the greater population growth rate estimated. Besides this, we demonstrate that even when the population growth rates are the same, the demographic mechanisms responsible for them can differ.

Poster D118

Do earthworms influence seed bank dynamic and plant succession?

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Soil seed banks are essential to understanding species establishment patterns and community structure. Among factors affecting soil seed bank, earthworms are increasingly recognised as important dispersers and predators of seeds. They might modify soil seed bank by a variety of earthworm-mediated mechanisms, such as selective seed ingestion and digestion, acceleration or deceleration of germination, and seed transport. However, the role of earthworms for seed bank dynamics remains little understood. The objective of this study was to analyse the role of earthworms on soil seed bank along a gradient of succession in chalk grassland (Normandy, France). Could earthworms play a role in the biodiversity and stability of grasslands?

The study was located on chalk grasslands of Upper-Normandy (North-West of France). In February, soil and earthworm casts –that contain seeds- were sampled in four different stages of the secondary succession from open grasslands to young woods. Each soil sample was divided into three depths (0-2 cm; 2-5 cm; 5-10 cm) to evaluate each seed composition and to compare it with cast seed composition. Species were identified at the seedling stage. Established vegetation was also analysed. We performed univariate analyses on species richness, density, and similarity (Bray-Curtis) and multivariate analysis such as Correspondence Analysis and coniertia.

Our results demonstrated than seed density and richness was often highest in cast samples than in soil samples. Additionally, we found a highest similarity between established vegetation and cast samples than between soil and cast samples. Surprisingly, cast seed bank was more similar with deeper soil seed bank than with upper soil seed bank. Along the successional gradient, seed bank density and richness (in cast and soil) were lower in the last successional stage (young woods) for all samples and highest in the intermediary stage. The contribution of each species within each compartment strongly differs.

In the discussion section, we will explore mechanisms that explain our results. We will try to define the role of earthworms- seed interactions at (i) the patch scale, (ii) the plant community scale and (iii) along the plant succession. We will also discuss the importance and intensity of these interactions.

Grassland plant diversity as modulated by species pools, soil fertility and community assembly history

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Plant ecologists have long sought to better understand the multivariate processes governing patterns of plant diversity within and among communities and along environmental gradients. Much work on this problem has focused on diversity along gradients of soil fertility, physiological stress, disturbance and productivity. However, a variety of stochastic and historical factors that influence available species pools, initial community states and community assembly trajectories may act to generate spatial patterns in diversity that emerge despite these gradients. Such historical phenomena may not only limit the explanatory power of the environment in predicting diversity but may potentially interact with environmental factors in complex ways to influence coexistence. We present results from a long-term community assembly experiment established in Kansas in 2007 to explore the interplay of initial species pools, initial community states and soil fertility levels in governing plant species coexistence and the development of diversity-productivity relationships in grassland. In 2007, 270, 2 × 2 m experimental plots were established on abandoned agricultural land and intensively planted to a variety of different initial community states in terms of species pool composition, richness and species abundances. In the sixth year of the experiment, the species richness of plots was still positively correlated with the number of species originally planted, consistent with species pool limitation. However, richness was also constrained by competitive exclusion as illustrated by: strong overall declines in richness in plots over time; and by increased rates of species loss over time as a function of species pool size, an indication of possible competitive saturation. Fertilization increased plant production, reduced light availability and reduced richness by further increasing rates of species loss. An interaction between fertilization and species pool treatment indicated that declines in richness in response to fertilization were dependent on species pool size. Independent of N addition and species pool diversity, the richness of plots varied as a function of plant composition which itself varied as a reflection of initial conditions and varied assembly history. Across the entire array of plots, richness varied unimodally with plant productivity. However the nature of this relationship varied with species pools size, ranging from non-significant, to monotonically declining, to unimodal. These initial findings indicate that responses of species richness to gradients in soil fertility and productivity can be strongly contingent on species pool diversity and community assembly history.

Grazing decreases AM colonization and N cycling in low Arctic meadows

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The effects of grazing on the delicate balance between plant, their fungal symbionts and soil nutrient cycling dynamics are still not completely understood. Most of the research focuses on temperate grassland system, while Arctic is still a widely unexplored land.

We aim to investigate how AM colonization rate and nutrient cycling dynamics respond to grazing in two low Arctic meadows. Even though previous results are contrasting, grazing generally reduces AM colonization while increases nutrient cycling rate.

We therefore hypothesized that grazing would decrease AM colonization and increase nutrient cycling. The two study sites are located in the Kilpisjärvi region in Jehkas (69°05'N, 20°47 E) and Saana (69°03' N, 20° 50' E). Both sites are south exposed meadows dominated by the grass *Deschampsia flexuosa*. A fence has excluded part of the meadows from reindeer grazing for 10 years. To test our hypothesis we collected three different AM plant species *Deschampsia flexuosa* (graminoid), *Solidago virgaurea* and *Potentilla crantzii* (forbs) inside and outside the fenced areas. For each of them we measures root AM colonization and shoot 15N content, which is linearly related with soil δ15N. Higher rates of N cycling are positively correlated with δ15N values as a consequence of the loss of 15N depleted products, resulting from fractionation processes occurring during soil N cycling. Our study shows that grazing reduces AM colonization, but the reasons behind the decrease are dependent on both environmental and plant characteristics. AM colonization in *D. flexuosa* decreased due to grazing in both study sites while a decrease in the other two species was observed only in one site. The conditional reduction of AM colonization might be the result of different mechanisms: i) a negative response of AM fungi to fertilization (i.e. dung deposition), mainly present in *D. flexuosa* ii) the increased cost of AM symbiosis due to grazing in a place where the environmental stress (nutrient limitation) perceived by *S. virgaurea* and *P. crantzii* is high. The negative effect on AM fungi of fertilization, rather than C depletion, was confirmed by a greenhouse experiment on *D. flexuosa*. Differences in nutrient availability and cycling are reflected also in shoot 15N signature. Shoot δ15N was negatively correlated with OM content, which was higher in the grazed area, suggesting that grazing decelerated nutrient cycling.

Poster A32

Community Classification of the Pawnee National Grasslands, Shortgrass Steppe, USA

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Species respond individualistically to environmental and geographic gradients, biotic interactions, and disturbances. However, plant species are often located in assemblages along environmental gradients based on their life history characteristics. Thus, vegetation communities may be classified and such classification allows managers to parameterize community characteristics, document their locations, and monitor changes. To date, no classification has been attempted for the Pawnee National Grasslands, so this base-line knowledge is lacking. Gaining an understanding of the complex nature of Colorado's shortgrass steppe will enable land stewards to accurately assess impacts from disturbances. We sampled 102 plots throughout the Pawnee National Grasslands and subsequently developed a classification of plant community types. Data collection followed the Carolina Vegetation Survey. Richness for all plots was 355 species out of a known 457 that are found on the Pawnee. Relatively few exotics were found, and they were restricted to wetter areas of the landscape. We used NMS ordination, canonical correspondence analysis, and species indicator analysis to develop community concepts and examine community-environment interactions. The gradient ranged from mesic *Juncus-* and *Carex-dominated* communities to dry rock outcrops dominated by grasses but with a diverse assembly of forbs. As expected, most of the gradient was dominated by *Bouteloua gracilis* and *Bouteloua dactyloides*. A total of ten community types were identified and related to environmental factors, and seven of these types matched fairly well with the US National Vegetation Classification. Based on significant relationships with environmental factors, a prediction of community types was modelled [mapped] onto a GIS landscape.

Is there a unimodal relationship between species richness and biomass in herbaceous plant communities? A global, multi-scale investigation

Lauchlan Fraser, Global PR Network

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Philip Grime's humped-back model (HBM) has been a cornerstone of plant ecology since its inception in 1973. However, recent studies have cast doubt on the generality of the relationship. In addition, the question of scale with regard to the HBM has not been adequately addressed. Here, we test the HBM within a nested multi-scale grid, incorporating 64 1 m^2 plots in an 8 × 8 m grid. The data have been collected by 29 groups, in 19 countries, on 5 continents. Our intent was to ensure representation across a range of site productivities and to include litter in the measurement of above-ground biomass per unit area. Our data supports the HBM model at the small spatial scales (1-4 m^2), but the relationship breaks down as scale increases.

Rizosphere processes and the expansion of invasive plant species

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Worldwide, invasive plants threaten biodiversity, by disrupting habitats and ecosystem processes, and cause major economic losses. The mechanisms that explain the success of invasive species remain unsolved, but rizosphere processes play a critical role. Invasive woody legumes, such as *Acacia*, are particularly aggressive, as they have impacts in the nitrogen content and cycling of invaded ecosystems, due to the ability to enter into symbiosis with nitrogen-fixing bacteria. Furthermore, some *Acacia* species can also change the morphological structure of the soil in places where they are the dominant species, reduce bulk soil density and increase its organic carbon content, and reduce plant diversity. Our work with *Acacia* will be presented to understand the role of soil processes in the expansion of invasive plants.

Poster D119

Nutrient additions in pioneer stages of sandy grassland: impact on phytodiversity and productivity

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Nutrient-poor sandy grasslands in Central Germany are threatened plant communities of high nature conservation value. A major threat could be an enhanced nutrient availability, e.g. by airborne nitrogen deposition or fertilisation, which could reduce species richness and the population of threatened species while increasing vegetation density and grass encroachment.

Hence, the objectives of our study were to assess the effects that continuous nutrient additions in low-productive sandy grassland can have on phytodiversity and on phytomass of different plant functional types (PFTs), by means of a field experiment. We continued the study of Storm & Süss (2008 JVS 19, pp. 343-354; until 2004/05) and Faust et al. (2012 JVS 23, pp. 372-386; until 2008/09) for another three years.

A five-fold replicated randomised block design with eight treatment types was installed in 2000 on a nature protection area in the Upper Rhine Valley, Germany, about 30 km south of Frankfurt/Main (Fauna-Flora-Habitat area 'Ehemaliger August-Euler-Flugplatz von Darmstadt'). The applied nutrients were: 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). Vegetation recordings were conducted twice a year (May & September) and phytomass was sampled once (September). Data were analysed by ordination (DCA) and mixed linear models.

Community composition was found not to be affected by nutrient addition until 2004/05; then the successional pathways separated between treatment groups without/low nitrogen dosages (N-: 0, C, P, n) and high nitrogen dosages (N+: N, NP, NPK, NPKM). Also in relation to phytodiversity, cover of PFTs and phytomass the results indicated a separation of the treatments into these two groups (N-, N+). In comparison to the N− group the phytodiversity was significantly reduced on the N+ treatments after a lag-phase of five years; same applies to the number of Red List species. In contrast, in the N+ group a significant increase compared to the N− group was recorded for the cover of competitive graminoids and the above-ground phytomass production of phanerogams; these distinctions between treatment groups began already in 2002/03.

High-dose N-deposition is the main driver of changes in our study system. As a first response to nitrogen additions the productivity of these sandy grasslands was enhanced; then, after five years, effects on phytodiversity and community composition became apparent.

Are there tradeoffs between cool and warm season growth in temperate woody vegetation?

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Herbaceous species of temperate ecosystems often inhabit distinct phenological niches, with some species growing largely under cool spring conditions (e.g., forest ephemerals, many C3 grasses) and others dormant until late spring or early summer. This may be driven by two different forms of growth, with species in early spring growing through cell expansion and warm-season species growing primarily via cell division. Furthermore, species of early spring growth phenology have been shown to have large genomes, potentially because the larger cell sizes associated with higher nuclear DNA content allow greater capacity for growth via cell expansion, but this may come at a cost to summer growth if greater DNA content slows down the rate of cell division and thus whole-plant growth rate. However, it is not known whether such constraints lead to a necessary tradeoff between spring leaf phenology and summer growth rate, or whether woody species exhibit the same constraints.

I measured the nuclear DNA content of 56 species of native and invasive shrubs and lianas of Eastern U.S. deciduous forests, and explored connections between genome size, cell size, spring growth phenology, and summer growth rate. Spring bud-break phenology, summer stem extension rate, and photosynthetic capacity were monitored over three years in a common garden, and nuclear DNA content and cell size were measured via flow cytometry and image analysis of stomatal guard cells. Across all 56 species from several genera, high DNA content was associated with early leafing behavior and was greater in native species, but with a weak association to cell size. For 18 species within the honeysuckle genus Lonicera, all seven native species had genome sizes greater than 2 pg,

and all 11 invasive species had genome sizes less than 2 pg, a correlation that was phylogenetically independent within the honeysuckle clade. Genome size, in turn, was a strong negative predictor of summer growth rate and photosynthetic capacity for this genus. Although genome size was not correlated with summer growth rate across all 56 species, invaders exhibited significantly higher summer growth rates and significantly lower genome size than natives. Results point toward a potential tradeoff in temperate woody plants between early season growth, accomplished via cell expansion in plants with large genomes, and mid-season growth rate, maximized in plants with small genomes capable of rapid cell division. Invaders show a tendency of maximizing summer growth rather than earlier spring leaf emergence.

Poster E171

Management of coastal pine forests for conservation of coastal vegetation

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The coastal pine forests are distributed on sand dune along the coastlines of Japan. This type of forest has been maintained by local residential people, because it has been provided food and materials for fuel and compost. Coastal pine forests have been protected from wind, sand, and natural disasters. However, many of these forests have been abandoned and suffered from pine wilt disease. Structure and composition of forests have been changing during these 40 decades. Coastal vegetation, which is remnant natural vegetation, is distributed on the floor of coastal pine forests. It is important to clarify the relationship between forest structure and coastal vegetation.

The main objective of this study is to clarify the structure of forests and understory vegetation of coastal pine forests. And we try to propose proper management for coastal pine forests. Study site was located at Keinomatsubara (N34 20 30, E134 44 11) at the southwestern part of Awaji Island, Hyogo Prefecture, Japan. The pine forest was divided into 40 × 40 m qurdrats. In each quadrat, numbers of pine trees and broad-leaved trees were counted and diameters of the 10 largest pine trees were measured. Species name and coverage of plant species were recorded in each quadrat. The distribution of broad-leaved trees, such as *Quercus phillyraeoides*, *Photinia glabra* and *Rhus succedanea* was restricted to the boundary between the pine forest and the residential area. More than 90% of quadrats were covered with sandy soil, which was potential habitat for coastal vegetation. Artificial severe disturbances and introduction of silt led to the decrease of biodiversity of coastal vegetation. *Linaria japonica*, a typical coastal plant in the study site was distributed on open site and forest floor.

It seems that maintenance of uneven-aged forests is important for conserving coastal vegetation.

Poster A33

Characteristics of species composition in mountain riparian forests in the Tenryu river originated in the Japanese Central Alps

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Japanese archipelago is a continental islands located along the east coast of the Eurasian continent. Japanese flora is composed by two elements: species distributed across the eastern Asia and endemic species in Japan. "SOHAYAKI" element is one of the important species group within the endemic species, which is mainly distributed at the southwestern Japan with low winter precipitation and old sedimentary rocks. Mountain riparian forests (MRF), especially in *Dryopterido - Fraxinetum* commemoralis (DFass) is one of the important habitat for the species of "SOHAYAKI" elements. Japanese Central Alps is important region of biogeology located close to one of the border of Japanese floral regions in the central Japan. However there are few reports about distribution and species composition of MRF along the upstream of the Tenryu river in the Alps. To obtain basic floristic information of MRF, we carried out phytosociological survey in 14 forest stands in 11 branches of the river. We researched on *Pterocarya rhoifolia* and *Fraxinus platypoda* dominated forest that is the main crown species of MRF. The climate is low winter precipitation in this area and main surface geology is granite and contains sedimentary rocks in the northern part. We compared the species compositions from the view of phytogeography using 163 stand data of MRF that had already been reported in the central Japan by sorting of relevé tables. In the result, distribution of MRF was rare except for one branch called Yotagiri valley. We identified *Cacalio yatabei - Pterocaryetum rhoifoliae* (CPass) in the northern branch and DFass in the southern ones. CPass possessed the species that are distributed in eastern Asia and few of the endemic element. DFass possessed few species of the endemic element. As a factor of the lack of MRF not only effects of artifacts such as erosion control dam, but also frequent large natural disturbances are considered. The stands of CPass were distributed in sedimentary rocks and granite covered area, while DFass distributed in grain covered area in the Alps. We could say that climate factor is more important for the occurrence of the endemic element in MRF in the central Japan, but there were some species of the endemic element that were not distributed in the newer surface geology. The result of DFass possessed few species of the endemic element in the Alps mainly covered by granite implied there exist some effects of more modern geological history.

Poster A34

Relationships between environmental factors and vegetation in depressions on peatlands and heaths with *Rhynchospora fusca* in Western Poland

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Depressions in peat substrates constitute very important habitat for rare and threatened plant and animal species (Natura 2000 habitat, code 7150). We investigated species composition and relative abundance of *Rhynchospora fusca* in depressions on peatlands and heaths in relation to measured environmental variables in 13 sites in western Poland. Relations between species composition in 76 plots with *R. fusca* and depth of water table (DWT), pH, conductivity and type of substrate, were analyzed with DCA and RDA. Altogether 48 taxa were recorded in vegetation plots: 33 vascular plants, 12 mosses and 3 liverworts, Most of the studied plots were characterized by acid (mean 4.6 pH) soft waters, with low electrolytic conductivity (mean 170 μS cm-1) and by mineral-organic substrates. Reaction (pH) and conductivity of water significantly explained 65% of the variation in floristic composition. RDA and cluster analysis revealed 3 main types of vegetation in the studied depressions. *Rhynchospora fusca* formed plant communities in a wide range of habitats: as pioneer communities of humid bottoms of drying out periodic pools, with plants usually growing in depressions in mineral substrate (with *Sphagnum denticulatum*, *Drosera intermedia*, and *Eleocharis multicaulis*), as well as in central parts of exploited peatland on temporarily waterlogged muck soils (with *Molinia caerulea*, *Pinus sylvestris* and *Campylopus pyriformis*) and on rich habitats of margins of old, not used fishponds, and pits (with *Carex panicea*, *C. serotina*, *Warnstorfia exannulata* and *Phragmites australis*). This study provides new data on the ecology and typology of *R. fusca* community in western Poland and suggests that occurrence of this type of vegetation is associated with places previously used or influenced by man e.g. through extensive peat exploitation, pasturage and fires.

Poster D120

Impact of plant-plant interactions and altitude on *Helleborus foetidus* demographic traits

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Positive plant-plant interactions are important forces driving community structure and composition. The effect of plant-plant interactions has been mainly quantified through the analysis of establishment and survival rates or plant performance. Recently, it has been shown that the intensity of facilitation is likely to shift depending on abiotic context and across plant life, and to affect functional traits. Similarly, demographical processes are expected to be affected by plant-plant interactions, although no study has evaluated it so far.

Our aim was to evaluate the impact of altitude and plant-plant interactions in the demography of the perennial herb *Helleborus foetidus* L. (*Ranunculaceae*). Specifically, we studied the impact of both factors on *H. foetidus* age structure, spatial pattern and demographic parameters (secondary growth and fecundity).

We sampled in three sites along an altitudinal gradient in Sierra de las Nieves Natural Park, southern Spain (36º41' N, 5º1' W). The lowest site was located at 1450 m a.s.l. in a Spanish fir (*Abies pinsapo* Boiss.) forest, whereas the other two sites were located at 1700 m a.s.l. and 1850 m a.s.l. above the treeline in areas dominated by the shrubby Savin juniper (*Juniperus sabina* L.). We collected 120 individuals at the highest and intermediate sites, 60 in bare areas and 60 within juniper canopies (microsites) to test for the interspecific effect. At the lowest place, where junipers were not present, we just collected 60 individuals.

We used univariate point pattern analysis with the pair-correlation function g(t) to explore the spatial patterns of *H. foetidus*, and a Chi-square test to analyze the relationship between *H. foetidus* and *J. sabina*. Probability of reproduction was analyzed with a logistic regression, whereas the number of leaves and flowers per plant were analyzed with generalized linear models. Radial growth was evaluated with an additive mixed model to control by age effect. Finally, all reproductive variables were analyzed together in a structural equation model (SEM), considering the different environmental situations.

Our preliminary results indicated an association between altitude and age structure, secondary growth and number of leaves. Number of flowers was related to leaf number and was not affected by altitude or microsite, whereas probability of reproduction was affected by microsite. The altitudinal gradient seemed to be more important in driving demography of *H. foetidus* than interspecific interactions.

Climate warming-induced heat events lead to intra-seasonal variation in productivity and community-aggregated functional traits at temperate latitudes

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Field experiments have demonstrated that warming can ameliorate cold and nutrient stress at temperate latitudes, but warming will also increase the frequency and intensity of episodic heat-stress events. These stress events can temporarily stall productivity and guide the functional and compositional structure of communities, but are generally unaccounted for in experiments that only measure productivity in terms of peak biomass. In this study, I measured productivity repeatedly throughout the growing season to test whether such a stress-augmentation exists, and whether these stress events account for unanticipated functional trait variation arising from a simple peak biomass-based model of vegetation change.

I used multispectral imaging to document intra-seasonal shifts in productivity induced by open top chambers. Open topped chambers were established in two wetland communities with distinctly different community structure in 2010 and reflectance in the visible and near infrared were recorded biweekly throughout subsequent growing seasons for chambers and nearby control plots. Community composition and functional structure were also recorded at multiple time-points during the growing season. I predicted that peak biomass would increase in warmed plots, but that heat stress events would lead to a shift in the shape of the productivity accumulation curve, indicating a more stressful condition in the mid-season when heat events are more frequent. I predicted that this increase in mid-season stress would lead to an increase in community aggregated traits associated with effective regeneration (decreased seed mass and plant height) or stress tolerance (decreased Specific Leaf Area) which would not be predicted using a peak biomass-based model.

Reflectance metrics indicated that productivity declined in the mid-season, but increased relative to controls in the late season, leading to no significant shift in total production for either community type. This was paired with a significant decrease in seed mass in one community, and a significant decrease in specific leaf area in the other with no discernible difference in height for either. These results suggest that climate warming can alter the functional composition of communities even in the absence of augmented total production, where traits relevant for regeneration and stress tolerance become more prevalent with an increasing frequency and intensity of heat events.

Poster A35

Analyzing community patterns in nested permanent alpine plots

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We have developed a test to check the consistence of a sampling on permanent plots used to check changes on alpine vegetation along time. Those plots (3 × 3 m) were distributed taking into account exposure and altitude and are subdivided in other smaller (1 × 1 m) that are also subdivided in 10 × 10 cm cells. In the middle of the bigger plot a datalogger is buried to have temperature values. So we wanted to know if sampling nested subplots were sufficient to detect changes on vegetation due to climate or other environmental factors.

Distance-based permutational multivariate analysis of variance (PERMANOVA, Anderson, 2001) based on Bray-Curtis dissimilarities (Bray and Curtis, 1957) on untransformed data were used to estimate variation and compositional differences in the multivariate assemblages between plots and subplots. The analyses tested the same hypotheses described above for univariate analyses but in a multivariate context (Terlizzi et al., 2005a). PERMANOVAs were done using the computer programs DISTLM.exe and PERMANOVA.exe (Anderson, 2001, 2004, 2005). We have also built the multivariate space by means of different usual approaches (DCA, NMDS). Results showed the differences among plots and subplots and the established relationships among the subplots.

Shrub encroachment lowers small-scale taxonomic and functional diversity in alvar grasslands

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Shrub encroachment is considered as one of the major threats to the conservation of semi-natural grasslands after land abandonment. In dry calcareous grasslands (alvars), the cessation of the traditional grazing has lead to shrub overgrowth, changing the environmental conditions and reducing species richness. However, little is known about how functional composition and diversity are influenced by shrub cover, although this information can provide a better understanding of how alvar communities respond to shrub encroachment. We studied the mechanisms by which shrub cover influences small-scale species and functional diversity in alvar grasslands in the islands of Saaremaa and Muhu, Estonia.

We sampled small-scale plant species richness and environmental heterogeneity in a gradient from directly under to outside the Juniper canopy in 24 alvar grasslands. In each grassland area, a 2 × 1 m plot was placed with the shortest side of the plot (1 m) in contact with the canopy of a Juniper shrub. We used a stratified random design to sample small-scale (10 × 10 cm) environmental conditions (soil parameters and relative light) and plant species richness. To measure functional diversity, we collected trait data of the most common species and quantified community weighted mean and functional diversity for leaf dry matter content (LDMC), specific leaf area (SLA), plant height and height:biomass ratio.

We found that small-scale species richness and functional diversity were positively related, and both increased with distance from the juniper canopy. Species richness increased mainly due to the increase in the number of alvar specialist species. Community weighted mean in LDMC and height:biomass ratio were higher outside than under the juniper canopy, while no differences were found for SLA or plant height. The influence of juniper on species richness and functional diversity was only detectable at distances up to 1 m. We also found an increase in soil moisture content, soil temperature and relative light with distance from juniper canopy, whereas soil depth decreased. Juniper modifies the small-scale environmental conditions in alvar grasslands enhancing further changes in plant species richness, composition and functional diversity. Near the juniper canopy, the environmental conditions favor the establishment of generalist plant species that exclude alvar specialist species. The loss of alvar specialist species and changes in the functional composition of the grasslands following encroachment can have serious consequences for the conservation of these species rich communities.

Community assembly rules above- and belowground in a natural grassland: functional and phylogenetic insights

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Recent studies have found that patterns and processes of plant community assembly differ above- and belowground due to contrasting abiotic environments, i.e. homogeneous light conditions vs. heterogeneous soil environment. Aboveground communities are often driven more by biotic assembly processes due to competition between similar species (limiting similarity, leading to trait divergence and phylogenetic overdispersion) or between dissimilar species (weaker competitors exclusion, resulting in trait convergence and phylogenetic clustering). Few studies have examined belowground assembly with some evidence for abiotic filtering (resulting in trait convergence and phylogenetic clustering) or random assembly processes governing root communities.

We studied small-scale functional and phylogenetic diversity above- and belowground in a species-rich mesophytic grassland in Estonia. We made direct comparisons of species composition in identical volumes (0.1 × 0.1 × 0.1 m) above and below the soil surface, along 10 1-m long transects. We used conventional species identification to measure aboveground richness and 454 sequencing that enables identification of roots and rhizomes from mixed-species samples.

Firstly, we considered all species detected in the 10 transects as the species pool and compared the functional and phylogenetic diversity of the species pool to the small-scale above- and belowground functional and phylogenetic diversity. We did not find support for biotic processes aboveground in functional traits or in phylogenetic diversity. Belowground we found highly significant functional convergence in root traits (taproot persistence and existence of clonal organs) and phylogenetic clustering suggestive of abiotic filtering. Secondly, we considered the belowground community as a species pool from which the aboveground community is filtered, because only species rooted belowground can (but may not) appear aboveground. We detected divergence in vegetative traits aboveground, in support of limiting similarity. However, we also detected convergence in root and reproductive traits. This suggests that dissimilar species are excluded from the aboveground space by weaker competitor exclusion.

Our results highlight that considering the belowground community as a species pool for the aboveground community has great potential to reveal assembly rules governing aboveground communities. Our results also support the view that multiple assembly processes, that are generally seen as mutually exclusive, are operating albeit on different traits and in different space (i.e. above- vs. belowground) structuring plant communities.

Diversity and evenness measures in palynology: New insights from the taxa accumulation curve

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Pollen diagrams are mainly produced from sediments that accumulate in lakes and wetlands, and only where the focus of the investigation is this particular ecosystem, palynological richness can be directly used to describe for example the species diversity of water plants in a lake. Pollen that reaches the lake or wetland from beyond its limits does not have a defined area of origin. The probability of a pollen grain to be deposited at a site decreases with distance of the parent plant from the site. In absolute terms this differs largely between plants depending on pollen production and dispersal properties. Thus palynological richness cannot be related to a particular area and may be best compared to the regional species pool. It depends heavily on the size of the pollen count, but there is no natural threshold that would indicate how many pollen grains should be counted per sample.

Despite these problems, palynology is an important tool to assess possible changes in terrestrial plant diversity over the late Quaternary. It is therefore important to explore which inferences can be made from the diversity of pollen types in late Quaternary pollen diagrams. This study explores taxa accumulation curves over consecutive samples in time and compares results to indicators of pollen sample evenness and palynological richness.

The resulting taxa accumulation curves represent power functions, which run linear in log-log space with occasional shifts in the slope of the linear relationship. Dividing these curves into individual linear segments yields periods of similar pollen evenness and taxa accumulation. The analysis is driven by presence rather than abundance of pollen types and the successive immigration of new taxa might not be distinguishable from the sampling effect. Consequently, times of changing diversity and evenness may not correspond to previously determined vegetation change, revealing new aspects of vegetation history. This analysis allows assessing the different combination of evenness and palynological richness, providing a new tool to infer past changes in terrestrial plant diversity.

Poster D131

Migrational lag or climate driven population expansion: How do we explain the postglacial vegetation history of central and northern Europe?

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Postglacial range expansions are used as an analogue to how vegetation may respond to climate warming, which raises concerns that plants may not be able to track current climate change. During the last glaciation, northern and central Europe was either covered by ice or too cold and/or dry to support extensive forests. With postglacial warming trees invaded these vast areas and pollen and other plant fragments from numerous lake sediments and peats document the successive increase in their abundance. Delays in the appearance of some trees in the sedimentary record has traditionally been explained by a slow spread of species from their last glacial maximum refugia, and referred to as migrational lag.

Using pollen data from the European Pollen Database (EPD) and published distributions of genetic markers in extent tree populations the postglacial spread of some common European trees was examined with the aim to gain insights into controls on the postglacial spread of species. The distribution of genetic markers in extant tree populations shows that the past spreading routes of species cannot always be consolidated with palaeoecologically determined arrival patterns, indicating that immigration was not always followed by population expansion. In addition, population growth rates were influenced by climate resulting in an apparent delay in the expansion of more northerly populations. Some species may have been present regionally for several thousand years at low abundances, before their populations started to grow. While the reasons for these delayed expansions are still controversial, delayed immigration was probably not the limiting factor in most cases. Consequently, spreading rates deduced from postglacial range expansions are potentially erroneous and misleading. Studies assessing the consequences of global warming should pay attention to potential shifts in abundance and dominance as documented by the palaeoecological record.

Regional rarity versus local scarcity in plant communities: Impact of species removal on model performance in constrained ordination

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Background – Vegetation datasets generally include many 'rare' species, i.e. species with a low frequency, which are responsible for a high proportion of zeros in the community matrix and thus for a high inertia in the multivariate response to be explained by constrained ordination. It has been argued that such rare species should be removed because they add noise to the analysis and reduce model performance. There is some confusion in the ecological literature between regionally rare species (RRS) with low frequency in a given dataset and locally scarce species (LSS) with low abundance in a given community, due to a general positive correlation between occurrence and dominance.

Objectives – Our purpose was to assess whether RRS and LSS play a different role in the ordination of community datasets and the evaluation of beta diversity.

Methods – To disentangle the role of occurrence and dominance, we applied to various vegetation datasets a progressive removal of either the least frequent species or the least locally abundant species. We assessed impacts on diversity estimates, and on the model performance of redundancy analysis, without or after pre-transformation of cover-abundance data.

Results – In all datasets, a significant positive rank correlation is observed between the relative frequency of the species and their mean relative cover in occupied plots. However, the variation in dominance is very high among RRS. Frequency distribution depends on plot size and on the heterogeneity of the dataset measured by multiplicative beta diversity. Heterogeneity decreases with the number of removed RRS, whereas it increases when removing LSS. With raw data or after Hellinger standardization, the fraction of explained variation (adjusted R^2) tends to increase only slightly when removing RRS, with a more sensible increase of the relative contribution of canonical axis 1. By contrast, progressive elimination of LSS, which mimics a lower sampling effort in each community, affects negatively model performance. Irregular changes induced by species removal may occur after binary transformation, strongly depending on the dataset. Generally, the removal of RRS clearly improves the performance of RDA after double standardization (chi-square), contrary to the removal of LSS.

Conclusion – Results show that the correlation between occurrence and dominance hides profound differences with critical impacts on vegetation analysis. Providing that meaningful transformations are applied, there is no need to remove rare species prior to RDA. Focusing only on dominant species during sampling is likely to limit the performance of ecological empirical models.

Plant functional types and traits: the holy grail and the devil in the detail

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Question: Is a universal set of functional traits desirable or achievable?

Location: Global, regional, local

Methods: The performance of functional strategies of resource capture trade-offs at varying environmental scales is briefly reviewed. This is compared with a whole-plant strategy in which uniformly collected biophysical data from 1980 transects worldwide are analysed using community weighted means of single and multiple trait assemblages.

Results: Parsimonious functional strategies based on orthogonal (independent) traits such as leaf, height, seed, perform more efficiently at global than at local scale whereas the converse tends to apply to strategies based on complex sets of largely covariant functional traits. Strategies that lack the orthogonal rigour of the more parsimonious systems may include covarying traits that are nonetheless fundamental to key elements of ecosystem function. This can include carbon assimilation that is mediated by patterns of chlorophyll distribution (hypo- vs. amphistomatous leaves), specific leaf area, leaf size, inclination, venation, longevity and phyllotaxis (e.g. rosettes) and ligneous or succulent green-stem photosynthesis. Readily observable traits that are sensitive to fine scale gradients of disturbance and resource availability are better indicators of biodiversity and functional trade-offs at community and ecosystem level than less observable traits or trait syndromes that target broader-scale elements of the resource. The multiplicative effect of such trait syndromes at fine scale raises questions about upscaling to theoretical models of ecosystem function as well as the validity of highly conservative traits currently used to evaluate the impact of global change on communities and biomes.

Conclusions: Increasing calls for conformity in trait selection, recording and analysis are confounded by ever-widening differences in scale and purpose. A unified approach to understanding response-effect dynamics of functional groups, together with their scale-dependency constitute one of the holy grails of plant functional research. If such an aim is desirable or practicable then achieving consensus will depend on how the science can be formulated to better accommodate the devil that lies in the functional detail.

Does the presence of invasive grasses affect fire behavior and severity in Brazilian tropical savannas?

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The African grass *Urochloa decumbens* is one of the most aggressive invasive species in Cerrado (Brazilian tropical savanna). Some invasive grasses have been reported to change fire behavior and frequency in the invaded habitat. Since fire is an important component of Cerrado, this study aimed to verify how *Urochloa decumbens* affects fire behavior and severity and if fire behavior changes according to season (July=dry season; October=beginning of rainy season) in cerrado invaded areas. The study was conducted at the Reserva Natural Serra do Tombador, Central Brazil. Experimental fires were conducted in "campo sujo" physiognomy (dominant herb layer, with scattered small shrubs), in four plots (20 × 15 m) for each treatment: Invaded area, July fire (UJ); native vegetation, July fire (NJ); Invaded area, October fire (UO). Before, during, and after the prescribed burns we measured weather conditions (temperature, relative humidity and wind speed), fuel load (dead biomass, coarse/stems and grass crowns, fine/leaves and culms of grasses and forbs, and *U. decumbens*, kg/m^2), and fire parameters (maximum temperature, rate of spread; flame height; residence time; burning efficiency; Byram's fire intensity). One-way ANOVA and Mann-Whitney tests were used to compare the variables between treatments (UJ × NJ, and UJ × UO). The weather conditions were quite similar in all experimental fires. The fuel load in NJ was significantly higher than in UJ (p0.05). All other variables did not vary significantly for both invasive × native, and dry x rainy season. Even with a lower fuel load in July, the presence of *U. decumbens* increased maximum temperature and the flame height of prescribed fires, while season did not affect the measured variables in invaded sites even with higher fuel load. Our study shows that the presence of *U. decumbens* can affect fire behavior in cerrados and probably bring ecological outcomes to system.

Challenges of combining null models and functional diversity in community assembly studies

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Null models are commonly used to study empirical patterns that are generated by various processes driving community assembly. Recently, they have been increasingly combined with functional diversity indices to investigate if coexisting species are more or less similar than expected by chance. The combination of null models and functional diversity measures have been used to disentangle the effects of interspecific interactions (mostly competition), and environmental filtering on community assembly, but also to tackle the more fundamental question if these processes are, at all, relevant for community assembly. However, despite the widespread use of null models, their theoretical implications are not always easy to grasp and the overwhelming amount of conceptual approaches and different randomization procedures can be confusing. For instance, randomized communities can be either created by drawing species from a wider species pool present at a given location or by shuffling cells in a site by species community matrix. In both cases, different constraints can be applied, and community data can be presence-absence or abundance based leading to a high number of possible combinations for randomization schemes. In addition, it is often unclear exactly which ecological mechanisms are included and which excluded when applying any given null-model although this is crucial for the interpretation of results. Therefore researchers often make choices based on assumptions or guidelines that are not supported by validation, and lack sufficient theoretical background. Here we give an overview of the existing approaches and algorithms used to generate null model communities. We will point out the shortcomings and pitfalls, and provide a theoretical assessment of how different null models affect the results of functional diversity measures.

Community responses to seasonally applied warming: a long-term microcosm experiment

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Early responses (year 4) to warming treatments (spring, summer, autumn, winter and unheated controls) applied to synthesized limestone grassland communities will be reported. Attention will focus on the role of "stored growth" and genome size on the responses of coexisting perennials and on contrasting effects of spring temperatures in 2012 and 2013.

Elevational shifts in plant communities is more pronounced at high elevations

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There has been observed a general tendency for species and communities to move upwards in elevation and polewards in latitude during the last decades. However, considerable variations exist between species and between regions in how large proportion is moving upwards and the magnitude of upward movements. Bertrand et al (2011) demonstrated that the elevational shifts lagged behind the climatic warming in the lowlands in France. To evaluate if this is a general trend we resampled data on species composition along seven elevational gradients in different arctic/alpine regions in Fennoscandia. A relationship between species composition of the original data set and elevation was established by Weighted Average (WA) techniques. Based on this relationship a transfer function was used to predict the elevation based on the species composition of the new data set. The difference between the predicted elevation and actual elevation for each sampling point in the new data set was found. If the predicted value was below the observed value it indicates that the species composition corresponded to a "warmer" vegetation type at higher elevation, and that the communities had shifted upwards. For five of the seven regions studied we found a statistically significant upward movement of species assemblages along the whole gradient. For five of the regions (including the two that did not show an overall significant relationship) the difference changed with elevation so that upward movement was most pronounced at higher elevations. Our results confirm the finding of Bertrand et al (2011) and indicate that lowland communities lag behind climate warming compared to communities at higher elevations where the composition is more responsive to the experienced warming.

Bertrand R. et al. (2011). Changes in plant community composition lag behind climate warming in lowland forests. Nature, 479, 517-520.

Extinction and extinction debt of plants and butterflies in Mediterranean grasslands: direct and indirect effects of patch and landscape characteristics on species density and richness

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There is increasing evidence that species richness of habitat patches in fragmented landscapes depends not only on patch and landscape area and isolation, as predicted by theory, but also on historical factors due to time delayed responses (i.e. colonisations and extinctions), type of organism, trophic dependencies and quality of local patches. Moreover, contrasting results are expected when measuring species at different spatial scales (e.g. habitat patches versus fixed-area sampling). However, all these issues have been rarely tested from a comprehensive perspective.

In this study we examine the effects of patch and landscape properties (area, patch isolation, patch quality) in 1956 and 2003, and patch area loss between these dates on vascular plants and butterflies in fragmented Mediterranean grasslands. In both organism types, the effect of those variables was assessed through model selection based on information criteria and structural equation modelling, separately for species richness (habitat patch level) and species density (fixed areas within patches) of both total and specialist species.

For plants, we found direct positive effects of current patch area on total species, and of current patch area and past surrounding grassland area on specialist species richness. Species density of total and specialist plants was negatively related to patch isolation and area loss. In contrast, total and specialist butterfly species richness only showed a direct positive effect of plant species richness, and an indirect positive effect of patch area (via its effects on plant species richness). Butterfly species density was positively influenced by plant species density and richness and by area loss and, indirectly by current patch area (through plant species density and richness). Species density of specialist butterflies was positively influenced by plant species richness and area loss, negatively by isolation and past patch area, and indirectly by current patch area (through plant species richness).

These results highlight contrasting effects of habitat fragmentation and landscape change on species density and richness for plant and butterflies, and high trophic dependencies of butterfly species density and richness on plant species richness. Direct effects of patch isolation and area loss were only detectable on species density, not on species richness. A decrease of both plant and butterfly species density is probably caused by small scale extinctions leading to a rarefaction –but not yet extinction– of those species at patch level, thus determining extinction debts. Future plant and butterfly extinctions are expected in the studied fragmented Mediterranean grasslands.

Poster D121

Shrub effects on grassland vegetation in Brazilian altitude grasslands

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The expansion of woody vegetation over natural grasslands, as observed in many parts of the world, has important consequences at the community and ecosystem levels. The shrub *Baccharis uncinella* (*Asteraceae*) is rapidly expanding in Brazilian altitude grasslands, mainly due to climate warming and suppression of fire or grazing management. The aim of this study was to evaluate the effect of *B. uncinella* on grassland vegetation community. We evaluated if its abundance affects grassland species composition and richness, and if it impacts specific life forms. Our study site was located in Southern Brazil, on the altitudinal grasslands in Atlantic Forest Biome (São Francisco de Paula, Rio Grande do Sul State). The regional landscape is composed of mosaics of native grasslands interspersed with Araucaria Forests. Cattle grazing and burning practices were suppressed, allowing woody species expansion on grassland vegetation. Surveys in areas with sparse populations of *B. uncinella* were done in 12 plots of 10 × 10 m within three 1 × 1 m subplots each. Six plots were located in area absent of *B. uncinella*, while the others were placed in a varied density of it (18-43 individuals). In each subplot, the identity and abundance of all plant species were determined and classified in life forms (shrubs, grasses, forbs and trees). We used linear regressions to evaluate *B. uncinella* abundance effects (from 0 to 43 individuals) on total and each life form richness. A total of 46 species (41% shrubs, 22% grasses, 35% forbs and 2% trees) in 15 families were registered, with 12 of them exclusive to plots with *B. uncinella* and nine exclusive to plots without it. Increased abundance of *B. uncinella* had a negative effect on grassland community richness ($R^2 = 0.35$; p = 0.045). Such reduction was specifically expressed in forbs ($R^2 = 0.54$; p = 0.001) and did not affect other life forms. *B. uncinella* presence in grassland communities alters light availability, and possibly physical and chemical conditions, thus affecting the ability of forbs to establish and grow. Forbs species exhibit morphological, life story and ecophysiological characteristics, which are at a disadvantage when light penetration is lower (e.g. height). *B. uncinella*'s capacity to invade adjacent grassland lacking management tends to suppress forbs survival mainly in response to light reduction.

Poster C79

The distribution of dry grassland plant species along road verges in agricultural landscape of the Zemgale Lowland: Preliminary results

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The research took place in the Zemgale Lowland, where agricultural lands cover 50-80%. Semi-natural grasslands are very fragmented there, they cover only 0.2% of the area and are located mainly in river valleys. Our goal was to assess habitat quality of dry grassland species located in road verges in terms of vegetation composition.

We inspected 50 km of road verges. Every locality of semi-natural grassland plant species was described if it was located not more than 20 m from the edge of the road. We described vegetation after the Braun-Blanquet method in 2 × 2 m plots – 1 plot in each locality.

21 species of dry and mesic semi-natural grasslands were registred in 94 localities during the expeditions. Widely distributed species with 12-38 localities were *Galium boreale, Galium verum, Primula veris, Carex flacca, Pimpinella saxifraga, Agrimonia eupatoria, Fragaria viridis, Plantago media*. Species distributed more rarely (2-6 localities) were *Filipendula vulgaris, Briza media, Trifolium montanum, Leontodon hispidus, Polygala comosa, Thymus ovatus, Ranunculus auricomus. Viola rupestris, Polygala amarella, Linum catharticum, Anemone sylvestris, Sedum acre*were registered only once.

Twinspan Analysis resulted in three plant communities. The *Plantago major–Elytrigia repens* community (27 relevés) was dominated by agricultural weeds. This community supported 10 species (1.2 species per location) characteristic to the semi-natural grasslands.

The *Leucanthemum vulgare–Deschampsia cespitosa* community community (52 relevés) were dominated both by mix of agricultural weeds and ruderal and grassland species. 13 dry grassland species (1.9 species per location) occurred in these localities.

The localities of the *Medicago falcata–Centaurea scabiosa* community (15 relevés) were more saturated with grassland species than others–17 grassland species were registered there (4.1 species per locality). This community occurred mostly in the the River Lielupe valley–the largest river of the Zemgale Lowland.

71% of described localities are considered as habitats supportive for grassland species. All so far registered semi-natural grassland localities of the surveyed region are located in river valleys. The results suggest that, outside of the river valleys, road verges are extremely important for the distribution of grassland species.

Poster D132

Assessing vegetation cover dynamics in response to climate variability at different time scales

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To evaluate human impacts on forests and other carbon-storing ecosystems, temporal patterns of vegetation cover status must be explained in terms of their causal factors. More specifically, the impacts of climate variability on vegetation dynamics must be identified, quantified, and separated from the impacts of human disturbances. A generic approach is to combine remote sensing-derived information about the vegetation cover status with meteorological data for a corresponding period and study area. A common method consists of correlation analyses between time series of Normalized Difference Vegetation Index (NDVI) and precipitation depths. We propose a number of methodological improvements related to the choice of variables, and the handling of periodic fluctuations at different time scales.

Previous studies have utilized standardized NDVI anomalies and anomalies of precipitation accumulated over variable time spans. However, we found that off-site and lag effects are better accounted for by using anomalies of soil moisture content as an indicator of climate variability. Since the soil pore space serves as a buffering reservoir for precipitation, we observed a more instantaneous and site specific correlation of soil moisture content with vegetation growth over a study area spanning East and Central Africa. Furthermore, the fraction of absorbed photosynthetically active radiation (fAPAR) is, as opposed to NDVI, a biophysical variable and is considered here to replace NDVI for further temporal analysis. Moreover, its sensor-independent characteristics allow the compilation of a 30-year time series.

The methodology to quantify the response of vegetation to variable climate conditions must be capable of detecting the time scales at which fluctuations occur. Time series of soil moisture content and vegetation indices display a clear annual periodicity, arising from the annual cycles of precipitation and the growing seasons of dominant vegetation types. As the objective is to understand climatic forcing beyond this seasonal response, all possible time scales must be accounted for in the analysis of the temporal signals of the explanatory variables. Therefore, time adaptive expansions of regular harmonic analysis are considered, and applied on univariate time series. Ultimately, bivariate analysis on a meteorological variable and a vegetation index will indicate which climatic fluctuations affect vegetation growth most. The preliminary results will be presented for the case of fAPAR (derived from NOAA-AVHRR and SPOT-VEGETATION imagery) and GLDAS soil moisture content, over East and Central Africa for a period of >30 years (1981 to present) at a 10 km spatial resolution.

Temporal analyis of population structure and dynamics of Caryocar brasiliense Cambess and Tachigali subvelutina (Benth.) Oliveira Filho in savanna, Fazenda Agua Limpa, Brasilia/DF

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Background: The Brazilian Cerrado is undergoing a fast transition from a natural ecosystem to an altered agricultural system and there is little data on the population dynamics of the principal woody species.

Objectives: The objectives of this study were to analyze and compare the population structure and growth patterns of two important tree species in the Cerrado, *Caryocar brasiliense* (Cb) and *Tachigali subvelutina* (Tv) in natural conditions.

Methods: Data were collected in four spatially separated 50 × 50 m² plots located in cerrado vegetation on the Fazenda Agua Limpa near Brasilia,DF, Brazil. The first survey was done in 1984 and 1985 and all individuals of both species in each plot were measured, height and circumference at 20 cm and DBH, and marked with aluminum tags. Since the initial survey, the plots were recensused at intervals ranging from 1 to 4 years and all live individuals were remeasured, recruitment of new individuals was recorded and these were measured and included in future censuses and any mortality or sprouting was also recorded for each species. All rates were calculated based on equations from Sheil

Results: A total of 12 surveys were made for Cb and 13 for Tv upto December 2012. The initial number of individuals found was 124 for Cb and 219 for Tv and the final number of individuals was 247 for Cb and 210 for Tv. Recruitment and mortality rates for Cb were 4.01 and 0.8%.yr-1 and 2.63 and 2.52 %.yr-1 for Tv. The number of individuals that survived the entire study period was 115 (92.7%) for Cb and 113 (51.6%) for Tv. For these groups, the mean increase in height and diameter was 0.06 m.yr-1 and 0.18 cm.yr-1 for Cb and 0.26 m.yr-1 and 0.47 cm.yr-1 for Tv. The population structure of Cb was significantly different between the first and last measurement due to recruitment of new individuals. For Tv, no significant difference was observed over the same time period. Both species have the capacity to sprout and produce new stems after disturbance.

Conclusions: The data reflect the differences in life history strategies of each species. *Caryocar* is a long-lived, slow growing species while *Tachigali* grows rapidly and has a much shorter life expectancy. Both species are capable of maintaining viable populations.

Functional comparisons of native and invasive plants in Eastern North American forests: do they differ in resource-use strategies?

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Studies in disturbed, resource-rich environments often show invasive plants to be more productive, but with similar physiological tradeoffs as co-occurring natives. However, in stressful habitats, it is unclear whether both groups of plants have common metabolic constraints, or alternatively, if invasive plants are more productive per unit resource cost—that is, use resources more efficiently. Using plants grown in a common garden, we compared leaf physiologies relating to resource investments, carbon returns, and resource-use efficiencies in 14 native and 18 non-native invasive species of common genera found in Eastern North American (ENA) deciduous forest understories, where growth is constrained by light and nitrogen limitation during the growing season. Invaders had significantly greater instantaneous photosynthetic and carboxylation rates but also greater leaf construction and nitrogen costs. This resulted in similar instantaneous photosynthetic energy-use (PEUE) and nitrogen-use efficiencies (PNUE). However, when integrated over leaf lifespan (LL), invaders had greater PEUE. This difference was driven by the lack of an expected tradeoff between LL and other traits, as invaders exhibited both greater photosynthetic abilities and longer LL. Invasive species had strategies that were more productive and more resource-use efficient. Our results indicate that woody understory invaders in ENA forests are not constrained by the same leaf-based metabolic tradeoffs as native species. These strategy differences could be due to pre-adaptation in the home range (primarily East Asia and Europe), although other explanations are possible. If differences in resource-use strategies are general, invader physiologies could have long-term functional implications for many temperate ecosystems as regional floras are reorganized through plant invasions.

Linking past with present: towards a wise use of analogues in vegetation ecology

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Vegetation ecologists are often interested in the roots of the vegetation they study. Assumptions about the past include for example long-term stability or recent establishment, weak or strong human influence etc. However, conclusions are usually based on short-term observations, with fifty or so years being considered enough to establish the basic dynamics of a plant community. By contrast, palaeoecology and historical ecology reveal that vegetation results from long-term interactions between plant species, their environment and humans. Palaeoecology uses recent vegetation structures as analogues in the interpretation of patterns observed in palaeodata (fossil pollen, charcoal, macrore-mains etc.). However, analogy does not necessarily involve immediate resemblance. Comparison of past and present patterns in vegetation poses considerable challenges. A cautious integration of approaches from several disciplines and a critical use of methods are necessary for success. However, vegetation ecologists tend to neglect advances in vegetation reconstruction and human history. Comparing crude sources using outdated approaches, one may easily produce biased and unrealistic outputs.

In our paper, we will critically analyze and connect various sources of knowledge used in a number of disciplines dealing with vegetation dynamics. We will present the strengths and weaknesses of analogue-based comparisons from palaeoecology across historical ecology to neoecology. Focus will be on data about vegetation composition in terms of species and communities, vegetation structure and human impact. Examples of obsolete and advanced methods will be given. We will also try to provide basic guidelines for vegetation ecologists as to how to study long-term vegetation dynamics using past to present analogues.

Vegetation responses to forest restoration in pine-dominated boreal forests

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Forest restoration is widely used in Finland to increase the structural variety of monoculture conifer stands. The main goal is to increase dead wood and to re-introduce fire-disturbance, which has been almost eliminated from our forests. The effects of restoration on understory vegetation have been rarely studied, since the research has concentrated mostly on threatened species of dead-wood dependent taxa (beetles, polypores). Changes in the vegetation reflect the overall succession of the restored forests.

We studied the effects of restoration on the cover, richness and composition of understory vegetation. The treatments included tree felling with two levels of downed dead wood with and without subsequent burning (15-20 m^3/ha; F1and FB1 and 30-40 m^3/ha; F2 and FB2) and intact controls. The treatments were replicated in four Natura 2000 areas in northern and eastern Finland, and each treatment was replicated in 8 to 12 plots in at least two of these areas, total n=58. We surveyed the vegetation from each experimental plot prior to the restoration and five years after restoration in 2005 and 2011 respectively.

The two levels of creating downed dead wood did no differ in their effects on vegetation irrespective whether they were carried out with or without subsequent burning. After restoration the species richness slightly declined or remained at the same level regardless of the treatment. Felling with burning increased the cover of forbs, graminoids and deciduous tree saplings, but decreased the cover of other functional groups. Felling without burning had only minor overall effects on the vegetation cover. The vegetation responses to restoration were dependent on the initial cover and richness, so that the changes were mostly negatively correlated with the pre-treatment cover or richness. The only exception was the change in graminoids cover, which was positively correlated with the initial graminoids cover. Species composition varied among the Natura 2000 areas initially and the differences in the response of study areas to burning treatment were clear.

Our study shows that the vegetation response to the restoration treatments varies depending on the initial understory vegetation condition. Especially in the felling treatment the understory vegetation cover tends to increase in areas with lower initial cover and to decrease where the cover and species richness is higher. Felling with burning influences both the species composition and cover. Practical implications of the results concerning restoration will be discussed.

Poster A36

Spatial isolation slows down directional plant functional group assembly in restored semi-natural grasslands

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Background. Ecological restoration schemes often assume that after reinstating appropriate abiotic conditions, plant communities will assemble following a single predictable pathway towards a fixed target state. This idea has recently been challenged, with increasing evidence that plant community assembly can only be considered deterministic at the plant trait level, rather than at the species level, and that the assembly outcome is largely influenced by the spatial context of the restoration site.

Methods. We surveyed 147 vegetation plots across a chronosequence of 22 restored semi-natural grassland patches to quantify the effects of spatial isolation on both plant species and plant trait assembly. Trait level assembly was analysed using an emergent group approach, based on 28 functional plant traits. Additionally, we examined the effects of several dispersal-related plant traits on species recolonization capacities.

Results. Whereas total plant species richness of the restoration patches did not change through space or through time, progressing assembly was found to consist of a sequential replacement of generalist species with specialist species, which was reflected by a directional assembly at the plant trait level. Grassland isolation was found to slow down community assembly at both the species and the trait level without changing the general direction of assembly. This slowdown became less pronounced with increasing time since restoration.

Spatial isolation of the restoration patches was found to act as a trait filter, independent of assembly age. We found a proportionally higher occurrence of species with light seeds and a high seed attachment potential in more isolated restoration patches, suggesting that colonization is more limited in isolated grasslands.

Conclusion. We demonstrate that the assembly process, at both the species and the trait level, is influenced by the position of the restoration patch in the landscape. Monitoring schemes following ecological restoration should therefore include the spatial context of the system while using both a trait-based and a species-based plant community analysis. Successful restoration requires physically interconnecting grassland fragments and probably the introduction of seeds or seedlings of species with low dispersability.

Traits of clonal growth – the missing element in the analysis of functional diversity of plant communities?

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Both key processes that drive ecological success of plant species, i.e. dispersal capacity and the ability to exploit a new habitat, are known to be affected by clonal (vegetative) growth. However, clonal growth is difficult to capture for large number of species, as plant clonal morphology is extremely variable and plastic and traits of clonal growth are thus much more difficult to analyze than e.g. LHS traits. Therefore only anecdotal information exists on their distribution and diversity in plant communities.

Here we present summary data on clonal growth parameters for the whole flora of the Czech Republic (clonal growth data for 1674 species, based on the database CLOPLA) and use them to examine differences among habitats in clonal traits and their within community functional diversity (assessed as under- or overdispersion for each trait). We also ask to what extent values of these traits are correlated with regional and local species abundance. To do this, we link the CLOPLA data with a stratified set of 20467 vegetation releves from the Czech National Phytosociological Database. To separate effects of habitat differences, we use classification of the releves into 32 EUNIS habitat types.

Community-wide means of clonal traits show remarkable variation across habitat types; for example, number of clonal offspring per parent plant and spreading distance differ fourfold across habitat types. Across-habitat differences confirm common-sense knowledge of highly unequal distribution of clonal growth habit across habitat types (e.g., low in agricultural fields and high in grasslands and wet habitats), and show also a number of unexpected patterns, namely on root buds presence, persistence of connections among ramets and bud bank. These patterns are indicative of action of ecological filters; however strong phylogenetic signal in clonal traits also needs to be taken into account. We also show that clonal growth is an important source of variation for species abundance, both at regional and (namely) local levels. In both cases, capacity for lateral expansion is correlated with higher abundance.

When the data set is broken to the EUNIS habitat types to reduce habitat filtering, clonal traits show both underdispersion and overdispersion depending on the trait type and habitat. Bud bank size is underdispersed in most communities except forests; in contrast, number of offspring per parent plant and spreading distance are the traits most likely to showing overdispersion. Such clonal traits are likely to contribute to niche differentiation (stabilization) mechanisms within plant communities.

Trees communities and filters to restoration along a periurban gradient of tropical forest degradation

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Periurban African dry forests are under high pressure for energy demand due to exponential development of cities. In the region of Lubumbashi (Katanga, south RDC), Miombo forest has declined dramatically during the last 20 years with a loss of about 80% of forest surfaces.

In this study, we characterize the pattern of floristic variation of Miombo tree communities in relation to soil chemical properties and herbaceous biomass in reference and degraded forests/savannah ecosystems in the periphery of Lubumbashi. Our specific aims are: 1) to identify limits to spontaneous regeneration of miombo communities after degradation, 2) test for change in chemical soil properties and herbaceous biomass that may hampers regeneration of miombo.

In three sites, we selected circular plots (18 m radius, N=53) in 5 different stages of the degradation/regeneration gradient defined on vegetation physiognomy (tree cover, tree height, herbaceous cover) : reference forest, degraded forest, wooded savannah, bush savannah, herbaceous savannah. All plots were situated in the same soil type: deep red soil. In each plot we collected tree species list, abundance of trees species (basal area for trees >2 cm), composite soil sample (analyzed for P, K, Ca, Mn, Cu, C, N, pH), dry herbaceous biomass. All trees <2 cm dbh (regeneration) were counted.

PCA followed by Kmeans classification revealed six major floristic groups. Floristic variation among plots showed a homogenization of species composition in savannas ecosystems. Species composition differed among adults (>2 cm dbh) and regeneration (<2 cm dbh) in most stages. Two communities were distinguished in reference forest: "Marquesia macroura/Brachystegia longifolia forests" and "Brachystegia spiciformis forests". Two species were presents in all communities: *Diplorhynchus condylocarpon* and *Baphia bequeartii*. *Albizia adianthifolia* was consistently present in the regeneration of all communities. Chemical variation (PCA) of soil was not related to communities and/or stages of degradation. Dry herbaceous biomass was significantly higher in bush savannah (7904 kg/ha) as compared to reference forest (2257 kg/ha).

Our study highlighted differences in regeneration potential between two references Miombo forests on deep red soil, highlighting potential differences in dispersal capacities and/or vegetative regeneration after disturbance. Modification of chemical soil conditions following charcoal production/agriculture do not appeared as a major filter to restoration. Increase in herbaceous biomass in degraded stages is hypothesized to be a filter to spontaneous regeneration of miombo forests in the Lubumbashi region.

Richness of arbuscular mycorrhizal fungi in relation to grassland plant richness and productivity

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Most terrestrial plants form associations with arbuscular mycorrhizal fungi (AMF) which play a key role in plant nutrient uptake and have been linked both to plant community richness and primary productivity, and hence to ecosystem function. However, little is known about how plant and AMF richness relate to each other in the field and how these richness measures link to above- and belowground components of plant community biomass. In addition, previous studies of plant-AMF richness relationships have not accounted for the richness of plant roots and rhizomes coexisting belowground We measured above- and belowground plant biomass as well as plant and AMF species richness in small quadrats (10 × 10 × 10 cm) in native North American grassland. Aboveground plant richness was measured traditionally, whereas belowground plant and AMF richness were measured using 454 pyrosequencing, utilizing plant trnL and fungal SSU rRNA genes. To examine the relationships among plant species richness above- and belowground, AMF richness and total, above- and belowground plant mass measures, we used partial correlation.

AMF richness was positively correlated with plant species richness above- and belowground. Belowground plant richness was positively correlated with belowground plant biomass and the sum of above- and belowground plant mass. In contrast, aboveground plant richness was not correlated with any aspect of plant biomass. Contrary to our expectations, AMF richness was negatively correlated with belowground and total plant mass.

Our results from natural vegetation confirm highly-controlled studies showing that richness of plants and AMF species are positively correlated, but the contrasting relationships among belowground plant richness, the richness of their associated fungi, and plant mass have hitherto been unreported. An important part of ecosystem functioning occurs belowground encompassing both plants and their associated AMF.

A mire chronosequence of New Zealand restiad mires or will'o-the-wisp?

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The development of New Zealand restiad mires, including both minerotrophic fens and ombrotrophic bogs, are presumed to be strongly controlled by autogenic processes, especially following the establishment of either of the two restiad ecosystem engineers *Empodisma minus* or *Empodisma robustum*. Investigations of the relationship between *Empodisma* distribution and mire environment along a mire chronosequence is expected to provide insights into the long-term development of restiad mires, by linking plant traits with changes in mire environment. 70 wetlands were surveyed over two summers throughout New Zealand, with the vegetation community and substrate chemistry of the sites described. The survey confirmed previous descriptions of the widespread nature of *Empodisma* distribution in New Zealand. *Empodisma* was found in a range of sites, including both seasonally and permanently waterlogged substrates, which ranged from very acidic to circum-neutral (pH=3.8-6.5), and comprised a gradient from mineral soils with <10% organic matter content, to Organic Soils with <2% ash content. Eight main types of *Empodisma* vegetation were suggested by the analysis, including montane fens and fernlands in the central North Island, *Empodisma-Leptospermum* vegetation on the Denniston coal measures, *Empodisma-Machaerina* communities incorporating mire edge and pakihi communities, and *Empodisma-Sphagnum* mires. The peat of the *Sphagnum* rich mires and montane fens are least similar, the *Empodisma-Sphagnum* communities having wet, acidic peat, with a low bulk density, compared to the dry substrate of sloping montane fens and fernlands which contain little organic matter. *Empodisma* capillaroid roots were common, except on the Denniston Plateau where little organic matter has accumulated, and in dry fernland communities dominated by *Gleichenia dicarpa*. Hummock-hollow topography was most prominent in the *Empodisma-Sphagnum* communities and under dense *Empodisma minus* canopies, with little surface microtopography evident in fernland, pakihi and mire edge communities. The survey suggests the growth-limiting nutrient in most restiad communities is P, however, nutrient enrichment has occurred at some sites, especially in *Empodisma-Sphagnum* bog remnants in Southland and Otago. The high *Sphagnum* component in these bogs has been previously attributed to anthropogenic changes in catchment hydrology, an increase in fire frequency and higher nutrient availability in the mires. As a result of these changes in mire canopy composition, a mire chronosequence incorporating the initial establishment and later consolidation of *Empodisma minus* along a fen-bog gradient, was unable to be constructed. Further study of ecosystem engineering upon mire development will rely instead on the use of an artificial fen-bog gradient.

Resilience of a sensitive Pannonian wet meadow to environmental change: a case study from Soroksár (Hungary)

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Changes in plant species composition and cover within a period of 20 years (1992-2013) are documented in this study by comparing two repeated vegetation samples combined with meteorological data, and considering past historical events. The mire meadow of Soroksár lies on an area of 20 hectares right at the edge of Budapest metropolis. The plant community that mainly characterizes the vegetation of this meadow is *Succiso-Molinietum hungaricae*, a drying mire community specific for the Hungarian lowland area (CORINE 37.311). The area is protected since 1977 and although formerly had many uses, since 1963 it is maintained only by one late summer moving. Earlier this activity was made by hand, but in the last 10 years mechanized moving was applied. The main source of disturbance is the highway, which was constructed in the vicinity and resulted in the decrease of the water table. This is currently the biggest threatening factor to the hydric regime of the meadow. We repeated the vegetation survey with the method used 20 years earlier, sampling 30 quadrats of 2×2m fixed along the meadow. Percent cover of each vascular plant species encountered was recorded. Although based on ordination and classification of the samples we could detect some changes in plant cover and the disappearance of some species, it seems that the main vegetation structure and the cover of the dominant species did not change significantly during the past 20 years. The results of the two–time vegetation uptake show that while being protected, this wet-meadow community has a good resilience to environmental changes. Changes in the meadow composition are mainly caused by large fluctuations of the amount of annual rainfall. Extreme precipitation events forecasted for the Pannonian lowland under global climate change associated with dry summers and prolonged high temperatures in addition to an increasing threat to the hydric regime of the meadow from the highway require a careful and continuous conservation management.

Bring the horses back: Grazing determines successional pathways of large-scale steppe restoration in Kazakhstan

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After the collapse of the Soviet Union the western Eurasian steppe zone between the northern margin of the Black Sea and the Altai Mountains has undergone tremendous changes in land-use and land cover triggered by deep-going political, social and economical transition processes. In Kazakhstan alone 15 Mio ha of crop land, originating from the so-called "Virgin Land Campaign" in the mid 1950s were abandoned between 1990 and 2000. At the same time stocks of domestic grazing animals such as sheep and goats dropped from about 20 Mio heads to less than 5 Mio. Since then, cessation of arable use and reduced grazing pressure has led to the recovery of steppe ecosystems over millions of ha across the entire steppe belt.

We studied vegetation and soil parameters on 150 plots of ex-arable land and virgin steppe remnants in the short-grass steppe zone of central Kazakhstan ca. 120 km southwest of the capital Astana. After 10-15 years of abandonment there were still significant differences between steppe remnants and the vegetation on ex-arable land especially in terms of floristic completeness of typical steppe species but also structural features. While the vegetation of grazed and un-grazed steppe remnants showed great similarity, we found strongly divergent successional pathways on grazed and un-grazed ex-arable fields. Under grazed conditions, ex-arable fields typically contained a high proportion of dwarf-shrubs of the genus *Artemisa* as well as perennial legumes and other herbs. Immigration of true steppe species was much more successful compared to un-grazed conditions, with typical grazing resistant grasses such as *Festuca valesiaca* and *Koeleria macrantha* as dominants. Under un-grazed conditions ex-arable fields developed to rather monotonous and species-poor stands dominated by the grasses *Stipa lessingiana* and *Leymus ramosus*. Due to the accumulation of dead standing biomass and litter in the absence of grazing such stands exhibit a very high fire frequency that further enhances the dominance of *Stipa* and *Leymus*. We conclude that without any grazing these fire-prone grass-dominated systems will persist, obstructing the restoration of the original steppe vegetation.

Poster A5

Wild ungulates in abandoned landscape – disturbance regime and diversity of semidry grasslands

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The importance of wild ungulates in European landscape increased in the last few decades, with frequent abandonment of agricultural areas. Wild ungulates partly replaced livestock activities that are an important part of disturbance regime. These include influencing secondary succession by grazing, browsing, trampling and soil disturbing.

Our study area is a part of the military training ground Doupovske hory Mts. (western Czech Republic, Central Europe). Since abandonment in 1953 secondary succession runs there and the landscape is now a mosaic of forest, shrub and open area patches. These habitats host large populations of ungulates (*Cervus elaphus, Cervus nippon, Capreolus capreolus, Sus scrofa*). Their impact on vegetation has long been the subject of our interest.

The study presented here is focused on small scale soil disturbances caused mainly by wild boar and their impact on diversity of semi-xerothermic grasslands vegetation (*Festuco-Brometea*) dominated by *Brachypodium pinnatum*.

We compared 30 artificial 1 × 1 m soil disturbances with undisturbed control plots. The experiment was established in 2007 and the succession was annually monitored for next four seasons (fytocenological sampling with percentage scale). With these data, we modelled the diversity – disturbance frequency relationship.

Natural disturbances occurring in the studied system were mapped three times a year to assess their frequency and dynamic. If it was possible natural disturbances of known age were also fytocenologically sampled to be compared with experimental data.

According to our experimental data both alpha and beta diversity increased on disturbed plots and remained high at least 4 years after disturbance. Data from natural disturbances support these results. The model results suggest that the highest level of diversity would be achieved under higher frequency of disturbances than is currently present in the studied system.

Disturbance regime caused mainly by wild boar thus increases heterogeneity and species diversity in semi-xerothermic grasslands. It leads to patches of different successional stages, and allows the occurrence of otherwise rare *Hyperico perforati-Scleranthion perennis* vegetation.

Poster C92

Plant community established on a restored gravel bed under frequent flood regime in the Tama River, central Japan

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Characteristic riverbank plant communities such as *Kummerovio-Asteretum kantoensis* have been decreasing along the Tama River. In study site, Nagata area there is one of few habitats of these communities left along the river. A direct cause of the decline of these communities is the recent difficulty of gravel bar formation. The decline of gravel bed is a consequence of decreased supply of gravel, resulting from artificial gravel mining and dam construction. In contrast, there has been an expansion of woodlands consisting of *Robinia pseudoacacia*, an alien tree. The community targeted for restoration is a short-living, so-called ephemeral plant community, whose formation and collapse are determined by flooding. As part of the restoration plan, flood frequency and gravel texture after restoration were examined. The planed inundation frequency of restored gravel bed ranges from several times of a year to once every five year. The plan had been executed in March 2002, to establish the conditions needed for reestablishing species of *Kummerovio-Asteretum kantoensis* and other riparian species. Monitoring was planned to identify how plant species invade and settle in the gravel bed created by the restoration. Primarily established plant community on the restored gravel bed was an annual mixed herb and grass community named *Setario-Bidentetum pilosae*. This community is common on the river bed, but some undesirable alien species, *Ambrosia trifida* for example, grew after the restoration. Species occurred in the early established community are mainly consisted of the species found as buried seeds in the sediments bought by flood. After restoration, several flooding occur until 2012. The gravel bed with low inundation frequency (once during 10 years), succession goes on from a short-living plant community to perennial and shrub communities. On the other hand, ephemeral plant community established on the gravel bed created at low level in height, which experienced several inundation events during 2002 to 2012, has maintained by flood disturbances. Change of species composition of the community was different in accordance with the intensity and scale of floods. Small flood accelerated accumulation of silty and sandy sediments and migration of weed plants on the bar, while large flood caused movement and accumulation of larger gravels and removal of perennial grasses and herbs. The result suggests the importance of frequent and intensity of disturbances for maintenance of the restored target plant community.

Poster C97

Fire history and vegetation dynamics recorded in sediment of the Komorany lake

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The former Komorany Lake (the Most Basin, Northern Bohemia) was a large open natural aquatic area, without any adequate analogy within the area of the Czech Republic. Thus, it is a site whose elaborate investigation poses a particular challenge. As the basin of the former lake has been completely destroyed by coal mining, recently rediscovered well preserved sediment profiles possess the last complete record of past environmental changes.

We aimed to reconstruct the fire history at the local and regional level by combination of three methodological approaches. Separate analyses of macrocharcoal particles (>1000 μm) originating close to the site and microcharcoal particles (<100 μm) from regional or extralocal fires were accomplished. (a) Large charcoals (>2 mm) were separated together with macrofossils. (b) Macroscopic and microscopic charcoals (100 μm - 2 mm) were recovered and quantified from sieved material. (c) Microcharcoal abundances were estimated by the microcharcoal-area particle analysis on the pollen slides along with pollen.

Charcoal and microcharcoal quantification and determination detect both natural and human induced fire dynamics. In order to distinguish the origin of the fire activity, complete palaeo-information based on multi-proxy data was obtained. Results indicate increased fire activity connected with human impact during Upper Mesolithic period (~6700 - 4500 cal yr BC) and Bronze Age (~2200 - 1200 cal yr BC) at the site.

Poster A37

The effect of current and past landscape structure and habitat conditions on species composition of dry grassland localities

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In the fragmented landscape, the distribution and dynamics of plant species are determined not only by local habitat conditions, but also by landscape structure and its changes over time and also by biological traits of species. There are, however, only a few studies dealing with the relative importance of all these factors. Moreover, most of these studies were carried out in forests and were dealing mainly with species diversity. The aim of this study was to identify the factors responsible for plant species composition in dry grassland-like forest openings in forested landscape of Křivoklátsko Biosphere Reserve in the Czech Republic and to indentify the relationship between species biological traits and species distribution.

Specifically, we examined the effect of current and past landscape structure and current habitat conditions on species composition at the study localities and assessed the relative importance of these three groups of factors. We analyzed information on past and present landscape structure using aerial photographs from 1938, 1973, 1988, 2000 and 2007. For each locality we calculated its total area and isolation in the present as well as in the past and the continuity of localities and additional information on abiotic conditions. At each locality we recorded all species of vascular plants and collected data about their biological traits.

The present distribution of dry grassland species in the study region is significantly affected by all three groups of factors. In addition to habitat conditions, species composition of the patches was determined mainly by past landscape structure, especially from 1938, whereas current landscape structure explained the smallest deal of variability. Perennial species with bad long-dispersal ability and species that are able to survive in seed bank for a long time prevailed at localities which were large and were not forested since 1938. On the other hand, species able to spread long-dispersal, species usually with ruderal strategy and with high nutrient demands prevailed at currently isolated localities. Overall, the results indicate that knowledge of past landscape structure is important for understanding species distribution at present and that species traits can be used as useful predictors of species response to landscape structure.

Poster D109

Ectomycorrhizal communities in bait seedling roots in relation to energy wood harvesting practices: processes behind observed differences

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Background: Impacts of energy wood harvesting on soil biodiversity and forest regeneration are largely unknown. We studied the composition of soil fungal community, especially the ectomycorrhizal fungi in Norway spruce *(Picea abies)* sapling roots, affected by different practices of intensive energy wood harvesting.

Objectives: The aims of the study were to assess (i) spruce sapling growth and (ii) root fungal diversity with taxonomic and ecological grouping in relation to energy wood harvesting treatments.

Methods: Nursery seedlings of Norway spruce were planted in 2008 in four treatments: 1) uncut forest control, 2) clear-cut + patch mounding, 3) clear-cut + 70% logging residue removal + patch mounding, 4) clear-cut + 70% logging residue removal + stump removal (25 stumps/ha left) + patch mounding. The experiment was established in three locations; south, central and north Finland in the boreal vegetation zone. Saplings were harvested in September 2011, their growth parameters measured, and root fungal communities studied by 454 pyrosequencing. Sequences were cleaned using the QIIME pipeline and clustered at 97 % using UCLUST as implemented in QIIME 2.15.0. For fungal identification, the obtained sequences were compared to open databases (GenBank, UNITE) using BLAST (MegaBLAST) program.

Results: In all locations (south, central, north), uncut forest control differed substantially from other treatments both in terms of sapling growth (lower in the control compared to all other treatments) and fungal community composition. Evenness and diversity indices were significantly higher in uncut control forest compared to other treatments with soil disturbance. No significant differences were found between three harvesting treatments. Most common species in the whole data was *Thelephora terrestris* representing more than half of obtained sequences. In the uncut forest control, *Piloderma* spp., *Russula* spp. and *Cortinarius* spp., were abundant. In the treatments 2, 3 and 4 fungal communities were dominated by *Thelephora terrestris*. Other abundant taxa in these three treatments, were *Tylospora* sp., *Amphinema byssoides*, *Wilcoxina* spp., *Meliniomyces* sp., *Laccaria* sp. and *Phialocephala helvetica*.

Conclusion: Mobilization of soil nutrients and changed inoculum potential due to soil disturbance associated to forest clear-cut and varying competitive and dispersal abilities of fungi are suggested to explain the results.

Poster C93

How to assess restoration success of self-restored *Sphagnum*-dominated system?

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Among the attributes suggested by SER (2004) the restored ecosystem should have the evaluation of diversity, vegetation structure and ecological processes are commonly taken to reflect well the recovery. In special case of peatlands the ultimate goal is considered to be the restoration of peat formation processes in the newly formed acrotelm.

We studied plant cover structure on two self-restored peatlands the transition from bare peat to *Sphagnum*-dominated system has lasted ca 30 years. The main objective is to assess about restoration success of self-restored *Sphagnum*-dominated system.

The recovery pathways differed between sites as found by chronosequental analyses of the newly formed acrotelm. Also, species composition, richness and present vegetation structure differed between restored sites and in reference sites.

The most essential ecological process peculiar to native mires, the peat formation in properly functioning acrotelm was reached within 30 years after the recovery began. From this standpoint and considering with temporal changes in the vegetation structure typical in succession it will be discussed about evaluation of restoration process of *Sphagnum*- dominated mires.

Poster C94

The potential of *Araucaria angustifolia* planted forests on inducing the secondary succession at Brazilian Mixed Ombrophilous Forests

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The Ombrophilous Mixed Forest used to cover an ample area in the South and part of the Southeast of Brazil. Since the 20th century, the increase of anthropic intervention has put the ecosystem in a critically threatened category and her typical species, the *Araucaria angustifolia*, in extinction prone. The researchers estimate that between 1% and 4% of the original occurrence area remains nowadays. Besides, restoration actions aimed at Mixed Ombrophilous Forests are limited due to the scarce knowledge about composition and structure of these communities on different successional stages, and also the effects of frequent disturbances on its dynamics, such as fire. The objective of this study was to evaluate floristic and structural differences among the regenerating components of stretches Ombrophyllous Mixed Forest at Southeast of Brazil, within the scope of rising hypotheses on its successional trajectory. It intends to appraise the potential of araucaria planted forests on inducing the secondary succession. This work was structured on two study cases of araucaria planted forests installed in the 1950s. The first one was the secondary forest under reforestation located in a well conserved forest matrix at Bananal municipality; the second one covers two patches of the reforestation located on Campos do Jordão municipality, but one of them was affected by an accidental fire of low intensity on July 2001. In each place, permanent plots were installed in natural and planted araucaria forests with similar soil and climate conditions. In order to sample the upper stratum were allotted 50 plots of 10 × 20 m, where all trees with perimeter at breast height (PBH) ≥15 cm were measured. In each one of these plots five sub-plots of 1 × 1 m were randomly placed, in order to survey the lower strata (total height >30 cm and PBH <15 cm). Results are presented according to the inclusion criteria of each component, in order to make quantitative comparisons between the upper and lower stratum in each place and among study cases. The diametric structure of the communities follows an inverted J-pattern, but the fire reduced the number of individuals, which was more severe in the lower strata. In all areas under secondary succession evaluated, we hope that araucaria forests continue their natural succession, resembling the surrounding forest matrix in the long term. The species demonstrated potential for being used on restoration projects of anthropogenic disturbed areas, even by monospecific plantations of araucaria, due to favorable landscape conditions.

Poster D102

Habitat tracking as a survival strategy in plants

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Natural environments are under successional change and its speed varies depending on habitat type. One strategy for species to survive in changing environment is adaptation. However, sometimes the rate of change can be too fast to plants to be capable to adapt for new circumstances. Disturbances are renewal forces in habitats, which reverse succession development. If disturbance cycle is very long, some habitats become unsuitable and a local population goes extinction. In these cases, dispersal of seeds to new suitable habitat is essential for preventing regional extinction. Consequently, in the course of time plant is tracking its habitat and the survival of species is more dependent on habitat dynamics than demographical processes. However, still most population viability analyses rely purely on population demography and ignore habitat dynamics. This can be detrimental for species living in habitats under fast succession. Using two rare plants we explored how well do short term demographic data project the long-term fate of populations and how it is related to the habitat succession. One study species was a perennial riparian plant, *Silene tatarica*, growing along a river with natural flood dynamics and a regulated river. In riparian habitats succession from open shores to forest is quite fast. On the other hand, we studied the effects of habitat change under slower succession using a northern species *Arnica angustifolia*, which grows on calcareous rock walls. In the riparian plant, growth rates varied largely among populations and the observed and projected population growth rates differed significantly in most populations. In the majority of cases population growth was overestimated. In the regulated river, the error correlated positively with the rate of habitat change. In the rock plant, high coverage of deciduous shrubs and tall mosses as well as the increase in temperature decreased the survival or size of plants. These results highlight the need of combining habitat dynamics to demographic models as well as the importance of habitat management in habitats under human impact. Variability of habitats is needed to keep habitat tracking in process and to buffer against climate change. Population isolation, restricted recruitment and habitat specificity decrease the possibilities for habitat tracking.

Management and high habitat connectivity enables fast recovery of grassland plot-scale plant diversity – but is that the diversity we desire?

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A long continuity of traditional, low intensive, grassland management has resulted in some of the world's most species rich habitats. Today these habitats are threatened worldwide by abandonment or intensified agriculture. It has been suggested, although debated, that linear grassland elements (LGE's) might be valuable for maintaining plant species richness in otherwise depleted landscapes were they could act as remnant sources and increase habitat connectivity. In traditional Satoyama landscapes of Japan, continuously managed grasslands have contributed to extremely species rich landscapes. In modern agricultural landscapes, most of the managed grasslands consist of newly established LGE's, e.g. paddy levees (PL) and road verges (RV). This was the first study analyzing landscape change, using historical aerial photos, together with field data on plant diversity in traditional and modern agricultural Japanese landscapes. The aim was to investigate the potential contribution of LGE's to plant diversity in modern landscapes in comparison to traditional landscapes.

We found a significantly higher plant γ-diversity of PL and RV in traditional landscapes, whereas α-diversity recordings of traditional landscapes (24.7 species/m^2, PL and RV) were just slightly higher than in modern landscapes (21.6/21.1 species/m^2, PL/RV). Among the total 216 species recorded, 201 (50 unique) were found in traditional landscapes, whereas only 160 (10 unique) species were found in modern landscapes. In modern landscapes, PL age overrode any other plot scale variable; PL established 1985-1995 supported higher species richness than PL established 1995-2008. We found no connection between landscape structure variables and plant diversity.

These results suggest that the colonization credit of new PL is settled quickly, as species establish fast, approaching almost the same α-diversity values as in traditional landscapes. This is probably a result of the regularly managed LGE's with high connectivity. However, the total species number is far from as high as in the traditional landscapes and many species associated with traditional management suffer from modernized agriculture.

In conclusion, as long as being continuously managed and connected throughout the landscape and with other landscapes, LGE's could be of great significance for enhancing plant diversity of semi-natural grasslands. However, long continuity of habitat management is still one of the most important contributors to plant diversity. Thus it is important to preserve those habitats and rather use LGE's only as an additional implement to facilitate species persistence, dispersal and colonization.

Poster A38

Spatial patterns of aquatic vegetation along environmental gradients in the polish, lowland river

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Key words: species diversity, macrophytes, environmental factors, ecology, river.

The relationships between spatial aquatic composition and environmental factors in the lowland Wełna river (W Poland) were studied. The meaning of 25 environmental indicators (water chemistry, hydrological, morphological and bottom futures) on the pattern distribution of aquatic vegetation in riverine ecosystem were tested. Among ecological factors rarely undertaken in aquatic ecology the light climate such as dissolved organic matter (DOM), dissolved humic substances (DHS) and coloured dissolved organic matter (CDOM) was concerned. Furthermore detailed hydrodynamic variables of water were measured (both velocity at the surface layer and in the zone containing aquatic plants). Among hydromorphological indicators e.g. depth of water, width of channel, riverbed materials, angle of bottom, shading of channel, banktop land-use and channel modification were noted. The field research were performed in 120 randomly appointed research plots of 16 m^2 during one vegetation period (June-September 2012) on the 30 km distance of the Wełna river. Field survey data included recognition of structure and species compositions of aquatic plants, as well as estimation of plants cover in the bottom. For each field plot mentioned above environmental indicators were measured.

The total number of macrophytes was 34 aquatic vegetation including: 4 macroscopic algae, 2 mosses and 28 vascular plants. The most often among algae occurred the freshwater red algae *Hildenbrandia rivularis* and the brown algae *Heribaudiella fluviatilis*, among mosses *Fontinalis antypyretica* and vascular plants were presented mostly by 2 dominant species *Sagittaria sagittifolia* and *Nuphar lutea*. Our results suggested that species richness in this lowland river is strongly dependent on just 3 abiotic indicators such as water velocity on surface and velocity in plants, temperature gradient and type of river bed material.

Presented results allowed to define 2 questions for further testing: 1) what is the meaning of biotic variable – macrophytes abundance and their cover in the river channel on the spatial pattern distributions? and 2) what is the significance of aquatic vegetation in the environmental factors creating?

Poster C80

Changes in bryophyte composition of species-rich meadows during 50 years in response to management (Ojców National Park, southern Poland)

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The Ojców National Park was established in 1956 to protect vegetation of deep valleys built of Jurassic limestone. In this time valley bottoms were dominated by fertile, species-rich meadows (association *Arrhenatheretum elatioris*) which were managed by mowing. Cessation of traditional management has led to far-reaching changes in species richness and composition of meadow communities. The main question was how bryophyte composition changed due to different management practices during 50 years. The vegetation in 17 semi-permanent 100 m² square plots was recorded using Braun-Blanquet method three times: in 1958–60, 1986–87 and 2011–12. To analyze actual cover of bryophytes 53 phytosociological relevées were made in 2011–12. Düll ecological indicator values for bryophytes were used. During investigation in 2011–12 27 bryophyte species were found. The number of bryophyte species at studied semi-permanent plots is higher now (16 species) than 50 (10 species) and 25 years ago (6 species). Data comparison shows that values of light and moisture indicators are lower and values of temperature and continentalism indicators are higher than 50 years ago in all plots. Changes in moisture and temperature values are the largest in those plots where active protection was conducted. Reaction indicator value decreased in comparison to 1958-60 in parts of meadows which were intensively used. There were differences in bryophyte cover occurred on meadows characterized by different management systems and microclimatic conditions. The largest cover was in extensively used meadows which were located in temperate warm and temperate moist slopes with northern or similar aspect and in active protected meadows located in very cold and very moist valley bottoms. The smallest cover occurred in extensively used meadows located in slopes with southern aspect. The study provides strong evidence that management regime and microclimatic conditions have influence on cover and composition of moss layer. Changes in the using of meadows lead to change of microclimatic conditions near ground. It should be take into consideration in species-rich meadows protection.

Poster A39

Landscape effects on alpha diversity in mesic meadows

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Mesic meadows of the *Arrhenatherion elatioris* alliance belong to common and widespread grassland types of the temperate Europe distributed over all types of geological bedrock. Due to their intermediate position along two important environmental gradients – moisture and nutrient gradients – their habitat conditions are suitable for a large variety of species and thus intensive penetration of species from surrounding habitats can be expected. The following questions are to be answered: i) Does the structure of surrounding landscape effect alpha diversity of mesic grasslands? ii) Which of the surrounding habitats contribute to alpha diversity of mesic grasslands and which species are supplied by them? iii) Is the effect of surrounding landscape dependent on altitude, climate or geology? Species data were extracted from Slovak vegetation plot database. Surrounding land-use (in terms of cover and diversity of various habitat types in plot neighbourhood) was derived from CORINE land cover maps and National Grassland Inventory. Along with total number of species in vegetation plots we considered number of target species (typical of mesic meadows), alien species and species typical of various (semi)natural and non-natural habitats. Alpha diversity was affected by both, percentage cover and diversity of different habitat types in plot neighbourhood. It increased with increasing proportion or diversity of different (semi)natural habitats and decreased with increasing proportion or diversity of non-natural habitats in surrounding landscape. The surrounding landscape affected both number and proportion of species typical of forest or non-natural habitats (including alien species) in plots. The obtained results can be explained by interplay of two main mechanisms, species pool and spatial mass effects. Financial support was provided by VEGA 2/0099/13.

Poster C81

Vegetation of Aukstumala raised bog under long-term anthropogenic activities

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Aukstumala raised bog is a locus classicus of modern peatland science (Weber, 1902). This raised bog has undergone anthropogenic impact since the end of the 19th century, when industrialized peat mining started. The greatest changes took place in 1968, when 2/3 of the bog area was drained. The Aukstumala Telmological Reserve was established in 1992 in the remained western part (1017 ha) of the former raised bog. Since 2004, this territory has been included into NATURA 2000 network.

The objective of the research was to identify the habitats of European importance and propose measures for the reduction of anthropogenic affect in Aukstumala raised bog.

Identification and mapping of the habitat of EU importance was made following the 'Interpretation manual of European Union habitats' (European Commission, 2007) and applying ArcGIS software. More than 130-year-long peat mining activities have affected hydrological conditions and vegetation of the raised bog. Now, the contact zone of the reserve and peat mining fields is about 6 km long, therefore, about 30–60 ha occur in the active zone of draining influence. The prevailing habitat type is degraded raised bogs. The vegetation is sensitive to changes in meteorological conditions and occurs in the area of high fire risk. This was evidenced by fire in 2011, when 270 ha of the reserve's margins were affected.

Five habitats types of EU importance and 210 plant species were inventoried in the reserve's territory in 2012. It was ascertained, that 23% (237 ha) of the habitats are significantly modified or degraded and do not meet the requirements for habitats of European importance. These belt-shaped habitats (40–500 metres wide) with dominating woody vegetation occur on the margins of the reserve, where anthropogenic activities are the most intensive. The largest area of the reserve's territory is occupied by habitats of Active raised bogs (7110*) – 59% (605 ha) and Degraded raised bogs still capable of natural regeneration (7120) – 16% (161 ha). Bog woodlands (91D0*) and Natural dystrophic lakes and ponds (3160) cover by 1% (10 ha) each of them. Some small fragments (<0.1 ha) of Depressions on peat substrates of the Rhynchosporion (7150) were identified in the areas affected by the 2011 fire. The research results will be used to develop the Nature Management Plan of the Aukstumala Telmological Reserve. It will include measures aimed to reduce the impact of anthropogenic activities to raised bog ecosystem.

Poster C82

To what extent we can detect secondary succession of grasslands in the dependence of different thematic and spatial resolution of reference data maps?

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European temperate grasslands heavily depends on direct (mowing) or indirect (livestock grazing) anthropogenic impact. Without that impact they are exposed to secondary succession process. During that process, they become replaced with shrubs and finally with forests. This inevitably leads to loss of part of biodiversity that we are trying to preserve and protect through the NATURA2000 and similar initiatives. In order to gain information about already lost grasslands, from which we can focus our efforts to most critical or most promising location for grassland conservation, besides current we need historical data. Very often these data differ in their spatial and/or thematic resolution. Here, we compared efficiency of grasslands extinction detection based on medium (Corine Land Cover –CLC) and large (vegetation/habitat) scale maps. Based on the availability of data, we have selected four nature parks in Croatia, two in Continental and two in Mediterranean part. CLC data were available for period 1980–2006. Historical vegetation data originated from 1970s and were made at 1:50000 scale, while current data on vegetation/habitats originated from period 2004–2010 on various scales (1:25000 for parks in the Continental part; 1:5000 and 1:10000 in the Mediterranean part). To enable comparison between vegetation/habitat maps, we had to reclassify maps to lower thematic resolution (from association to alliance or order). In frame of GIS we have calculated percentage of areas where grasslands disappeared, or are in process of extinction. For large scale maps we had conduct "cell by cell" analyses to detect "extinction phase", i.e. whether former grasslands are replaced by shrubs or forests. Use of CLC maps for change analyses resulted partly in complete absence of detected changes, while on the same thematic resolution usage of finer spatial resolution map yielded detection of significant changes. Although nature parks differed significantly in "starting" grasslands area (1 and 23.5% for Continental; 17.3 and 66.3% for Mediterranean), detected decrease was similar at regional level. It was higher in Mediterranean (49.5 and 50%) than in the Continental (38.2 and 30.4%). Higher decrease in the Mediterranean part could be partly addressed to slightly longer timeframe of compared maps. To reliably estimate secondary succession dynamics, data from at least three time periods should be used. Based on our results it seems that spatial resolution is more critical for successful detection of secondary succession in grasslands than thematic one.

Plant trait distribution in subalpine grassland of the European Alps across a productivity gradient

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Mountain meadows in the Alps are known for their outstanding plant species diversity. The traditional land use in the montane altitudinal zone is hey production for winter fodder. In the transhumance land use system, cattle is kept during summer in vast areas of the alpine zone (Almen).

Here, we analyze the spatial patterns of an array of plant traits across six study sites representing a gradient from subalpine wet meadows of relatively high productivity (about 45 species per site) to subalpine grasslands of low productivity (about 80 species per site).

Following a standard protocol for coordinated biodiversity assessments (see also Fraser et al. 2013), we recorded plant species identity and community biomass at the site level (8 × 8 m in area each) and within sites at the plot level (one square meter each) resulting in 96 releves in subalpine grassland of the Austrian Alps. All sites are located near Piller within less than 5 km in distance on siliceous bedrock with comparable climatic conditions. Precipitation reaches about 1800 mm p.a. and mean annual temperature is 6 °C. Altitude ranges between 1200 and 1400 m asl. The vegetation has never received fertilization and is prone to one or two harvests per year.

Reference: Fraser et al. 2013 Front. Ecol. Environm. 11: 147-155.

Patterns of vegetation diversity and plant species diversity across European countries

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Whilst plant species richness has been intensively studied at large scales, the diversity patterns of plant species and vegetation types have been scarcely compared. Here we test to what extent richness and beta diversity of (i) vascular plants and (ii) vegetation types show similar patterns in large European regions, and how the climate and geography influence both estimates of biodiversity. We used a comprehensive database with national-based occurrences of 789 vegetation types (alliances) and 6500 species reported in 17 countries and supra-national regions of Europe. The number of plant species and vegetation types per country were explained similarly by temperature factors, geological diversity and area, although species richness was additionally influenced by potential evapotranspiration and precipitation. Multivariate analysis of countries revealed strong and similar geographic patterns in plant species and vegetation types, pointing out major differences in the countries of the southern peninsulas from the rest of Europe, and defining consistent clusters for the countries of Central Europe and Boreo-Atlantic regions. In addition, Mantel tests revealed significant correlations between the dissimilarities of vegetation types and species composition with climate and geography. Our results at large spatial resolution agrees with the general latitudinal patterns determined by other studies, suggesting that both plant species and vegetation types can be similarly used as surrogates of biodiversity. Furthermore, we highlight the capability of vegetation types to define biogeographic patterns at large scales.

Keywords: latitudinal gradient, macroecology, species richness, vegetation types

Comparing the efficiency of random vs systematic arrangement of sampling units in vegetation ecological studies

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The efficiency of vegetation sampling is not a subject of a heated actual debate but one of ongoing discussions. Various sampling schemes and arrangements of field plots have evolved in plant ecology. Whereas in classical phytosciology plots are often placed preferentially, most recent approaches that aim for numerical treatment of the gathered data use random, and a smaller number of studies uses systematic distributions of sampling units.

We present an analysis of sampling efficiency and compare species composition data gathered with random vs systematic sampling from the same coastal brackish fen in Northeast Germany. Data were gathered in 2009 and 2010 on ca. 60 systematically placed (equidistant grid) and 60 randomly placed circular plots with radii of 1m (approx. 3.15 m²). According to the variance (expressed as total inertia) of increasingly sized subsets of the data, systematic sampling is much more efficient compared to random placement of plots. The usability of equidistant grids for efficient vegetation sampling and implications for global change research are discussed.

Poster D133

The maintenance of the diversity of ground-layer lichens in alvar grasslands and alvar-like habitats

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Alvars are calcareous grasslands which are formed on thin soil on Ordovician or Silurian calcareous sediments or on monolithic calcareous bedrock. The lichen vegetation is usually well-developed on open rock surfaces or on alvars with soil thickness less than 5 cm. We targeted our study to quantify the effect of the environmental conditions and historic disturbances on the species richness, cover and composition of lichens, observed in 86 habitat fragments in western Estonia. We distinguished four main types of alvar grassland: plate, ryhk, shingle and heath alvars. In addition, we defined three types of alvar-like habitats that have the potential to be substitution habitats for epigeic lichens: limestone quarry floors, coastal areas with young shingle and deforested areas on alkaline base rock. In each site, we described lichen species composition and environmental variables in a circular plot of 0.1 ha.

In total we found 122 lichen species growing on soil, on epigeic bryophytes and on plant debris. We found that the ground lichen communities were primarily soil-type-specific, but were also affected by historic disturbances and land use change. Lichen species richness was the highest on plate alvars and old limestone quarries; and the lowest species richness was observed in heath alvars and old shingle alvars. Species of conservation value were most sensitive to environmental conditions and land use change. The increased density of the herb layer and the reduced diversity of microhabitats caused a decrease in species richness, but only within the species of conservation value. The increased density of the herb layer also led to a shift in the composition of lichen growth form from the dominance of squamulose and crustose towards fruticose lichens.

We conclude that in addition to the practice of restoring alvars by cutting shrubs grazing is important to maintain ground layer lichen diversity. Grazing creates various small-scale ground disturbances and increases microhabitat heterogeneity. Alvar-like habitats originating from large-scale historic disturbances appeared to be suitable for calcicolous epigeic lichens, and can therefore be considered to be temporary substitution habitats.

Poster A40

Vegetation and species richness of the small archipelago in the Bothnian Bay National Park

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The vegetation of Baltic archipelago was studied in SW Finland. The number of vascular plant species on each island (N=26) was counted during several visits (1-6) and thus, the average species richness per visit and the cumulative species richness were obtained for each island. The area of each island was measured, the age was estimated based on the highest elevation and the vegetation was studied. The hypothesis that the number of vascular plant species on each island mainly depended on the area of the island with the highest elevation, an indicator of the age of the island.

The vegetation types on islands can be divided to the following groups:

Geolittoral herbaceous vegetation

Rocky shores with *Potentilla anserina* and *Glaux maritima*

Meadows with *Rhinanthus serotinus, Parnassia palustris* and *Ophioglossum vulgatum*

Accumulations of *drift algae* in upper geolittoral with tall herbs such *Valeriana sambucifolia ssp. salina*

Epilittoral meadows and outcrops

Dry meadows with *Deschampsia flexuosa, Silene nutans,* lichnen and shrubs

Mesic meadows with bird fertilization

Scrubs
Juniperus communis and *Hippophaë rhamnoides* thickets

Forests
Alnus glutinosa and *Sorbus aucuparia* forests

Dry and mesic shrub dominated pine *(Pinus sylvestris)* forest

Mesic and herb-rich spruce *(Picea abies)* dominated forest

Bogs

Geolittoral vegetation can be found on all islands. The soil type influences the vegetation: Kallioluoto is rocky and Santakari is composed of sand and gravel. The vegetation of the archipelago differs clearly from the vegetation of the mainland. While the hydrolittoral reed stands are fairly common on mainland, they are rare on islands. The substrate of the vegetation tends to be coarser on islands than on mainland due to stronger wave forces. On islands the vegetation zones are less developed than on the mainland.

Among the vulnerable species on islands are *Antennaria dioica* and *Galium verum* and among the nearly threatened ones *Centaurium pulchellum* and *Linun catharticum*. There are also some exotic species, which have only recently arrived to the area such as *Ligusticum scoticum, Ranunculus cymbalaria* and *Rosa rugosa*, which has invaded somewhat earlier. The Baltic coastal flora is threatened by exotic species, eutrophication and slow-down of land uplift due to climate change. Part of the Gulf of Preiviikinlahti belongs to the National Park of the Bothnian Bay. Some islands are private nature reserves.

Poster A41

Diversity of vegetation of low mountains in the Blida Atlas (subhumid stage)

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Keywords: Algeria; landscape; ecosystem

Mediterranean landscapes in low mountains are known for their floristic heterogeneity, which is the result of actions by various ecological and human factors.

These landscapes are the most threatened and least known natural landscapes in Algeria today. Our work is a contribution to the study of anthropogenic impacts and climatic disturbances on the vegetation diversity of a landscape of the piedmonts of the Blida Atlas just south of Algiers.

Vegetation diversity was analyzed at two levels of observation. The first is the landscape level, through the production of a vegetation map showing the spatial distribution of the various landscape units. The second level is that of ecosystems, through systematic sampling, and floristic and ecological inventory (66 relevés with 210 species). This permitted us to carry out a qualitative and quantitative evaluation of the vegetation and flora, and to appreciate the floristic, taxonomic, biological and phytogeographical situation of these vegetation groupings, which are threatened with disappearance by the actions of man and a changing climate.

Poster A6

Vegetation succession on river gravel bars after an extreme flood

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Rivers with gravel accumulations are a significant landscape phenomenon and their habitats are endangered due to stream regulations. Vegetation typical of gravel bars (e.g. *Salicion elaeagno-daphnoidis*) is dependent on a regular but not too strong disturbance by floods.

The main goal of this study is to describe succession and resilience of vegetation on gravel bars after a strong disturbance event. How does vegetation of early successional stages changes with time under natural conditions without human intervention? How do species composition and diversity change in different phases of succession?

Reestablishment of vegetation and vegetation dynamics on the gravel bars along four small streams in the Moravskoslezské Beskydy Mountains and their foothills (NE Czech Republic) were studied using vegetation sampling in permanent plots. There were extreme floods in May 2010. On the studied streams, the flood had a reached a magnitude of a 50-year flood event. Vegetation on the gravel bars was removed, some bars were covered by new sediments and some were newly created. I recorded vegetation plots on gravel bars two months after the floods and resampled them in 2011 and 2012.

The plots were established along the entire length of streams, from their sources to the mouths. In the first two years the number of species and Shannon diversity on gravel bars were strongly increasing. In the third year the increase was slower and on one of the streams the number of species decreased. At this successional stage vegetation on gravel bars became more continuous and competitive species started to dominate. The total cover of vegetation was significantly higher and evenness lower than in the previous two years. Tall herbs established mono-dominant communities on some gravel bars. Large areas were covered by *Urtica dioica* and invasive species, especially *Bidens frondosa*, *Impatiens glandulifera*, *I. parviflora* and *Solidago canadensis*. On some bars shrubby vegetation began to develop. The most species-rich plot recorded contained 72 species per 15 m², one year after the flood.

During three years the vegetation on gravel bars developed from the sparse initial stages to dense stands. In the second and the third year from the floods some plots were very species-rich. The number of species was continuously increasing. In the last year more competitive species started to prevail.

Poster D146

Alien species pools: another determinant of the habitat level of invasion

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The growing number of studies that reveal habitats to differ significantly in the number of alien species received (level of invasion) has led to a quest for the responsible mechanisms. Numbers of alien plant species in habitats have been shown to be determined by (i) habitat invasibility confined by habitat properties and (ii) propagule pressure. Here we suggest another important factor: (iii) number of species adapted to various habitats within the global pool of aliens. Habitats in the native range of alien species donate different numbers of their species as invaders to other regions. These species are adapted to their donor habitats and thus can have an advantage while invading analogous habitats in the invaded range. As a consequence, particular habitats can by highly invaded if analogous habitats in remote areas provide more species for invasion.

Using a model of alien species exchange between Europe and eastern North America, we analysed the relationship between the numbers of native species donated from particular habitats of the native range for invasion and the numbers of these species found as aliens in analogous habitats of the invaded range. We used the Czech National Phytosociological Database and the Carolina Vegetation Survey Database to identify 12 habitat types occurring in both central Europe and eastern North America. We randomly selected 6059 vegetation plots of an area of 10 m² and 100 m² assigned to these habitat types. We used sample-based rarefaction to calculate the number of native species donated as aliens by each habitat in one region and the number of alien species received by analogous habitats in the other region, i.e. the level of invasion.

We performed major axis regression and found that habitat levels of invasion in one region positively depend on the numbers of species donated by analogous habitats in the other region. This relationship was significant for both the invasion of European plant species to North American habitats ($R^2 = 0.285$, $P = 0.035$) and invasion of North American species to European habitats ($R^2 = 0.241$, $P = 0.030$). Our results indicate that habitats can have higher numbers of alien species not only because they are more invasible, but also because there is larger proportion of alien species ecologically compatible to them within the global alien species pools.

Poster B69

Getting more out of atlas datasets – how occurrence and range atlases supplement each other

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Background
Large-scale species distribution datasets are commonly used to determine species richness patterns, to calibrate species distribution models, to identify priority areas for conservation purposes, or to fill gaps in our knowledge of species occurrence. Plant atlases can provide valuable sources of information but vary considerably in their spatial extent, spatial resolution and taxonomic coverage.

Objectives
We outline a framework for assessing data quality distribution in large-scale species distribution datasets. We used the widely-used Atlas Florae Europaeae (AFE) and the lesser-known Atlas of North European Vascular Plants as working examples to evaluate data quality distribution.

Methods
We digitised range maps of 2049 taxa in the Atlas of North European Vascular Plants and compared these with occurrence maps of 3773 taxa in the AFE. For each species we calculated latitudinal range, longitudinal range, area of occupancy, and level of agreement in species distribution between the two atlases. To calculate level of agreement we mapped the Jaccard similarity index and reduced major axis (RMA) regression residuals for the entire atlases (5221 taxa) and for the intersection of co-occurring species (601 taxa).

Results
Species distribution range and frequency distribution of area of occupancy did not differ significantly between atlases. This indicated sufficient overlap between datasets to justify a further comparison. The Jaccard similarity distribution revealed a high level of agreement for central, western, and northern Europe. The distribution of RMA residuals concurred that AFE data quality was relatively low in under-sampled areas (e.g., Russia, Belarus, and the Ukraine). For most of south-eastern Europe, however, the Atlas of North European Vascular Plants contained more data of co-occurring species than the AFE, suggesting that AFE data quality was relatively poor for southern Europe too.

Conclusion
We demonstrated that atlas data quality can be much more heterogeneously distributed than often assumed. The comparison of occurrence and range maps showed that a pre-emptive exclusion of regions has two major disadvantages: 1) a premature exclusion of under-sampled regions can be a waste of useful data, and 2) the quality of what is left of the dataset remains heterogeneously distributed and may at places still be unsatisfactory. We recommend analysing occurrence and range maps in parallel to estimate the spatial distribution of data quality within each. A merger of the two can then be used to supplement gaps.

Poster A42

Rapid upward trends of upper altitudinal limits of exotic plants in montane grassland

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Background
Invasive alien species are regarded by the Convention on Biological Diversity (CBD) as a major threat to biodiversity. Monitoring trends in invasive alien species is therefore one of the CBS indicators to detect threats to global biodiversity. Such trend analysis requires development and maintenance of spatially explicit national or regional databases. However, a lack of existing datasets and resources is often a major hindrance in developing such databases. Monitoring the altitudinal distribution of exotic plant species may be a cost and time-efficient alternative whereby upper altitudinal limits of exotics are regarded as a proxy of their geographical distribution range.

Objectives
Our objective was to test trends in upper altitudinal limits of exotic plants as a proxy of their geographical range. Specifically, our aim was to detect trends in exotic plants along an altitudinal gradient by monitoring the presence of exotics and their upper altitudinal limit over a six-year period.

Methods
Our study area was a 20-km road stretch located along an altitudinal gradient in the Drakensberg, South Africa, with an altitude ranging from 1500–2874 m a.s.l. Each January, for a period of six years (2008–2013), we walked down this road recording the altitude of the three highest observations of annual and perennial exotic plant species.

Results
Over time both the cumulative number of exotics and the average number of annuals increased. Repeated-measures ANOVAs showed an upward trend of 138 m for annuals (N = 17 species), and 70 m for perennials (N = 28). Observations of annuals were randomly located along the road while perennials were spatially clustered around one of four dwellings as potential points of introduction.

Conclusions
The species increase and upward trend of annuals was too rapid to be explained by climatic change or time past since species introduction. Instead, the road's verges were regularly disturbed by erosion and maintenance, creating unoccupied habitats, while traffic (vehicles and hikers) likely facilitated the introduction of new species. This suggests strong and continuous propagule pressure as a major cause of rapid exotic range expansion, especially along roads and near dwellings. Finally, the monitoring of upper altitudinal limits of exotics showed to be a time-effective means to detect trends in invasive alien species. However securing the financial and institutional support to uphold such monitoring schemes remains a major obstacle in spite of increasing awareness of the value of long-term data sets.

Poster A43

The potential of developing meadows on former arable fields to harbour meadow specialist plant species

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Meadow is a successionally dynamic ecosystem and to an extent the replacement of old meadows with new and developing ones is expected. If the speed of this turnover exceeds a certain threshold, the share of new meadows will exceed the share of old ones. However, it is not known to what extent the developing new meadows can host species of old and species-rich semi-natural meadows and compensate for the loss of the latter as habitats.

We studied 8 mesic meadows at the age of 1 to 20 years developed on arable fields in order to clarify the ability of the developing new meadows of harbouring species of old and species-rich semi-natural meadows and compensating the loss of the latter as habitats. Further, an old meadow was studied as the reference site in an agricultural region of Estonia. For each site vegetation sward parameters and environmental parameters were described. Also the local species pool was compiled. To estimate the contribution of new meadows to preservation of meadow plants we determined specialist species at each site. For the analysis we used DCA and CCA ordination and indicator species analysis.

The studied meadows followed reliably the age vector on DCA ordination graph, showing the trend of increasing share of meadow species, decreasing nutrient level etc. Some *Carex* species turned out as indicators for the oldest meadow, as they were absent in all developing meadows. Moreover, 27-40% of the meadow species were in common between the 20-year-old meadows and the local species pool. We will present the relationship between the species occurrence and age vector determined in CCA ordination and describe the dynamics of the development of the species composition. In general, meadows evolving on arable fields have low potential to function as habitats for meadow specialist plants during early decades of their development. Thus, they can only partially compensate for the loss of old meadow habitats.

Poster E172

Biodiversity and recreational use overlap in protected areas

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Land transformation through human land-use is considered to have the most significant effect on biodiversity change in terrestrial ecosystems. Human activity has caused considerable habitat loss and fragmentation worldwide, which are the main reasons for the decline and even extinction of species and populations. Biodiversity changes have ecological, social, and economic consequences. Loss of species affects ecosystems processes and ecosystems resistance and resilience to environmental changes. Nature-tourism is an intensively growing land-use which often concentrates on areas with high biodiversity values, like protected areas. Protected areas are attractive tourism destinations and the number of protected areas, as well as the visitor numbers to protected areas, has increased worldwide. In Finland, for example, the number of visits to national parks has increased on average 6.5-fold since the beginning of the 1990s. However, tourism and recreation inevitably affects the terrestrial and aquatic environments. As nature conservation is generally the main purpose of the protected areas, the increased recreational use is challenging the management of these areas. In fact, recreational use is considered one of the major threats to the ecosystems of protected areas and it has become one of the main factors causing species endangerment. Therefore, it is essential to understand interrelationships between biodiversity and tourism to manage protected areas in a sustainable manner.

Our aim is to investigate the interrelationship between biodiversity and tourism in protected areas at two different levels. First, we study whether recreational routes of national parks are situated on areas with higher biodiversity in each park. Secondly, we will explore the relative importance of biodiversity and tourism services -related variables in explaining the variation in number of visits to national parks in whole Finland. For the study we have obtained data on all 35 national parks from Metsähallitus. According the preliminary results, on average the number of red-listed species (species diversity) and habitat types (habitat diversity) were higher near recreational routes compared to control areas. Consequently, there is spatial overlap between biodiversity and recreational use within national parks. Furthermore, we found that the number of visits Finnish national parks received annually, i.e. their attractiveness, was positively associated with the number of habitat and species diversity of parks. In future, habitats and locations with high biological values should be taken into account more carefully in the planning of protected areas to which new GIS-based tools gives a cost-efficient solution.

Changes in small scale vegetation pattern on mud-bottom hollows over 14 years in Männikjärve bog, Estonia

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Boreal bogs are recognized by their patterned surface topography and plant cover dominated by *Sphagnum* mosses. In Estonia mires began to reach bog stage ~ 7000 years ago. Since then established microforms and associated plant communities have been quite stable. However, mud-bottom hollows, from small patches to several hundred square meters in size, with degenerated *Sphagnum* mosses and a surface formed by blackish algal mat are also common for most raised bogs, though their changes may occur much faster. Since in mud-bottom hollows peat accumulation is replaced by it's decomposition they become lower, compared to surroundings with ongoing peat accumulation, and thus they may initiate differentiation of micro-topography and trigger changes in plant cover.

The focus of this study was to determine how long mud-bottom hollows can exist, what characterizes their overgrowth and whether they initiate changes in plant cover. Seven 1×1 m² permanent study plots were marked on mud-bottom hollows in three autumns 1998-2000 in Männikjärve bog in central Estonia (N 58o52'55'', E 26o14'87''). Plots were photographed in each autumn until 2012 and noticeable differences in plant cover from the previous year's photograph were described. Photographs were scanned, photo distortions removed and plant cover maps were created by identifying four plant cover types: A) healthy *Sphagnum* with vascular plants, B) necrotic *Sphagnum* with few vascular plants, C) almost bare peat surfaces or with few plants, and D) bare peat surfaces overgrown with tussocks of vascular plants or by *Sphagnum* mosses. The Markovian chain model was used to determine the stability of, and probability of transitions between plant cover types. Annual changes and probabilities were calculated to estimate how much each plant cover type has changed.

Changes within the plant cover types were cyclic, differed almost ten times and averaged 20±8% yr⁻¹. Although changes during the observation period exceeded 90% of the plot area, some bare peat patches persisted. Mostly they overgrow by the expansion of bordering *Sphagnum* carpet or especially by *Rhynchospora alba* plants. Although the changes in plant cover type, edge index and succession were significant and of a cyclic nature, quantification of this dynamic to meteorological conditions remained elusive, due to opposing influences. One can conclude that though mud-bottom hollows are common features on raised bogs, they are not as stable as other microforms and they initiate relatively fast changes in the bogs' plant cover.

Assessment of variation and diversity of invasive *Solidago* species in Lithuania

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Alien *Solidago* species are considered among the most aggressive plant invaders becoming dominating species in ecosystems very soon. The potential distributions of goldenrods are substantially larger than their current invasion in Europe. The research was aimed to investigate dissemination of goldenrods and identify their diversity in habitats of Lithuania. In order to implement the task of the research the combined botanical and analytical methods for ecological, morphological and karyological studies were used. We assessed size and variation of quantitative (steam height, inflorescence length and width, leaf length and width) and qualitative (steam colour and pubescence, leaf pubescence, leaf serration density and depth) morphological characters of plants in 46 populations of *S. canadensis* and 24 populations of *S. gigantea*. Somatic chromosome numbers were counted to identify ploidy level of plants.

Initially, invasive species of S*olidago* occupied abandoned fields and human impact habitats: roadsides, peat lands and banks of ditches. The biggest populations were found near big cities. *S. gigantea* has also established in semi-natural and natural habitats. Both species formed mixed stands rather frequent. *S. gigantea* often formed dense homogenous stands, while populations of *S. canadensis* usually consisted of diffusely widespread genets showing high phenotypic and phenologic variability. *S. canadensis* highly varied in all measured characters. Five different morphological groups were distinguished among plants. The most discriminative characters were leaf pubescence and stem colour. The principal components analysis (PCA) reduced five qualitative characters to two principal components which explained 79.5% of the variance and formed no clusters among the plants. Accordingly, chromosome counts revealed no variability, only diploids (2n=18) were found.

Populations of *S. gigantea* showed no significant differences according to the qualitative characters, while they into five clusters using quantitative measures were grouped. PCA indicated that 82.9% of total variation in quantitative characters was explained by the first two factors. The chromosome counts revealed that *S. gigantea* consisted only of tetraploid (2n=36) cytotypes. The morphological plasticity is considered as essential factor contributing to the invasiveness of the *Solidago* species. Despite the high morphological and ecological diversity only single cytotypes – diploid and tetraploid were found indicating selective introduction of both studied species. The factors influencing the invasion success requires further research.

Poster D134

Does vegetation structure in disturbed bogs indicate alterations in bog functioning?

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Bogs are important sinks for atmospheric carbon (C), which accumulates as peat due to extremely nutrient-poor, anaerobic and acid environment. Anthropogenic disturbances, like drainage and air pollution, may induce secondary succession in bogs toward forest-like ecosystems and enhance peat decomposition. The main aim of our study was to investigate complex and still poorly understood interactions between C dynamics, environmental factors and vegetation structure in disturbed peatland ecosystems. We hypothesised that vegetation structure and composition are determined by the same environmental factors as C fluxes, and therefore could serve as proxies for upscaling flux measurements and assessing bog functioning (i.e. C balance).

Study was conducted in forested bog margins that formed a human-impact gradient. Three of the study sites were situated in North-East Estonia (Kalina and Selisoo bogs) and affected by drainage, peat mining and alkaline air pollution; reference site was chosen from the Alam-Pedja Nature Reserve. In 2009, two plots of 300 m^2 were established in each site for the vegetation survey and monthly C emission measurements. Understory biomass and productivity were estimated in randomly placed sample quadrates, tree stand basal area, volume and tree biomass increment were measured in 100m^2 subplots. Tree litter was collected from the plots throughout the year. CO_2 emissions from peat were measured by applying soda lime method and methane effluxes by using portable FTIR gas analyser. Water table depth (WTD) and soil temperature were recorded simultaneously with the gas flux measurements. Peat samples were taken for the chemical analyses from the 0-15 cm layer.

Ordination analysis revealed that species composition was mainly determined by the peat pH, C content and average WTD. Largest changes had occurred in Kalina, probably caused by the alkaline air pollution from the power plants. However, CO_2 and methane emissions were not significantly different between Kalina and the pristine site. C emissions were strongly related to the WTD: ~10 cm difference in the average WTD led to more than twice higher annual peat respiration loss compared to the pristine site, while species composition and productivity did not respond to small changes in hydrological conditions. Thus, bogs with similar physiognomy may have very different C balance. On the other hand, stand basal area and volume were related to the average WTD and C emissions. Therefore, we suggest that stand structural parameters could be good indicators of C fluxes from poorly drained peatland forests.

Poster C83

Which plant species are "winners" in anthropogenic landscapes?

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During the last century, anthropogenic impact has led to extensive fragmentation and loss of natural and semi-natural habitats, rendering many species vulnerable to local extinctions due to changed environmental conditions. Decrease in historical habitat area and change in environmental conditions can lead to substantial turnover in species composition. While number of species are threatened and declining due to habitat changes, there are also several species that can benefit from altered conditions and show an increase in both species richness and in population size. Turnover of species can give rise to novel species assemblages i.e. to novel ecosystems, which can be compositionally and functionally different from the historical communities. We study the highly degraded grassland systems in northern Estonia that have experienced vast area loss and decline in grassland habitat quality during past century. By comparing the historical (1923) and current species inventories, we investigate to what extent the community has experienced a compositional turnover and characterize life-history traits of plants that can be considered as "winners" in altered habitats.

Poster E160

Molecular analysis of selected species of *Taraxacum* sect. *Palustria*

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RAPD analysis was applied to six species of *Taraxacum* belonging to the sect. *Palustria* (*T. brandenburgicum, T. subpolonicum, T. subdolum, T. bavaricum, T. belorussicum* and *T. paucilobum*) and ten individuals of unidentified species of *T.* sect. *Ruderalia* (external group). The studied plants differed in the number and length of products generated in the presence of 11 primers, and distinct molecular differences were observed both between and within analysed species of *T.* sect. *Palustria*. The percentage of polymorphic DNA bands ranged from 10.5% in *T. subdolum* to 18% in *T. brandenburgicum*. Particularly interesting result was the finding of relatively high (15,5%) DNA polymorphism in *T. bavaricum* in which all studied individuals originated from one mother plant. The four obtained DNA bands were common to all species of *T.* sect. *Palustria* and absent in the external group. The results fully confirm the commonly accepted concept of the division of the *Taraxacum* genus into sections and of distinguishing small apomictic species.

Poster A44

Spatio-temporal community dynamics of tree/shrub species during 117 years of heathland to woodland succession

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In Denmark, as in most European countries, the area covered by heathlands has been decreasing mainly following intensification and technification of agriculture over the last 200 years. However, during the last decades, conversion into woodlands after cessation of traditional management has become an increasing concern for the conservation of these habitats. The mechanism behind tree colonization and subsequent community dynamics are complex and poorly understood. Long term successional studies provide an opportunity to analyze and understand the ecological processes and factors that determine the outcome of secondary succession. Nevertheless, studies on spontaneous succession are rare. We used a unique monitoring study in which the post-abandonment tree and shrub encroachment has been followed and used to study the effect of dispersal and land-use history on the development of the tree/shrub community on a 350 ha heathland in the shouthwestern part of Denmark. The area was divided placing a grid of 400 × 400 m, resulting 33 quadrats where colonizing trees and shrubs were registered in 9 occasions between 1921-2011. Abundance and species richness were higher in quadrats closer to the edges of the heathland, contiguous to forest remnants. In general, succession followed a directional trajectory from pioneer to mid-successional species. However, the identity of the colonizing species was spatially determined by the proximity to seed sources. Land-use history was ambiguously important in determining the composition of the community only at initial successional stages. A fluctuating pattern of community heterogeneity was characterized by initial and late phases of homogenization and an intermediate convergent phase, and was determined by the community dynamics of this system. Dispersal limitation was an important factor in determining community assembly patterns, but this effect weakened during the course of succession.

Poster D135

Is the semi-arid herbaceous Mediterranean vegetation resilient to rainfall variation?

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Semi-arid ecosystems in the Mediterranean Basin are considered among the most vulnerable to climate change. In this region climatic models predict less precipitation, higher temperature and increasing seasonal and inter-annual variation in climatic conditions. Here we studied the effects of nine years of rainfall manipulations on the annual productivity (i.e. above-ground biomass), composition and diversity of the herbaceous vegetation in a semi-arid region (300 mm rainfall/year) with high dominance of annual species. During the study period a trend of decreasing rainfall occurred in the region. Superimposed to this trend, rainfall was experimentally reduced or increased by 30% in five 10×25 m plots per treatment, using rainout shelters and irrigation setups. Thus, amount of rain was changed during rain events, while natural distribution of rainfall during the rainy season was maintained. Vegetation was sampled at flowering and peak biomass in the spring, using 20×20 cm quadrats.

Annual herbaceous productivity varied strongly among years, was negatively and linearly related to total amount of rain during the growth season, but did not respond to rain manipulations. Species Richness and Shannon-Wiener Diversity Index varied across the study years matching the regional drought trend, and were slightly increased by both the irrigation and drought manipulation treatments due to effects on the less common species. In contrast, Shannon's Equitability Index gradually increased across years and was not affected by the rainfall manipulations. Similarity analyses showed small, negligible differences in species composition among rainfall treatments. Overall, despite inter-annual differences in the herbaceous community associated with the drought cycle and differences in total seasonal rainfall, the superimposed rainfall manipulations applied during nine consecutive years did not modify patterns of change in community composition. The apparent resistance showed by the annual plant community to the increase or the reduction of rain amount during rainfall events can be attributed to its adaptation to inter-annual rainfall variation larger than the applied treatments ($\pm$ 30%). Moreover, a nine year span of time is probably too short to induce significant changes in a plant community resistant to short-term variation in climatic conditions. Alternatively, variation in the size of rainfall events is probably less effective for community change compared to variation in the distribution of rain events during the growth season, a scenario to be studied in further research testing the resilience of herbaceous Mediterranean communities to rainfall variation.

Poster E173

Basic Research on Plant Selection for Ecological Experience of Rural Tourism Village, Korea

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While demand of rural tourism has been increasing recently, rural tourism is mainly focused on farming experience nation-wide. In this situation, recently popular ecological experience deserves to be introduced actively. Therefore, this study surveyed vegetation of ponds and small streams where are distributed in most of rural tourism villages, to analyze traditional knowledge, based on the survey results, and to select species for main use in ecological experience, based on main dominant species.

For this study, 10 rural tourism villages were selected where 11 ponds and 9 small streams are distributed. The vegetation survey was carried out in September, and Floristic Specific Species Designated and Naturalized Plants were analyzed to be used for experience.

As the result of the survey on the 11 ponds, total 246 Taxa (35~85 Taxa) were confirmed as 84 Families, 134 Genera, 211 Species, 30 Varieties, 4 Forms, and 1 Subspecies. In the 9 small streams, total 170 Taxa (24~61 Taxa) were confirmed as 55 Families, 92 Genera, 146 Species, 22 Varieties, 1 Forms, and 1 Subspecies. In Floristic Specific Species Designated, 4 Taxa in the ponds were confirmed, which were *Potamogeton cristatus*, *Aristolochia contorta*, *Nymphoides peltata*, *Utricularia japonica* and 2 Taxa in the small streams were confirmed, which were *Aristolochia contorta*, *Microstegium japonicum*. However, Naturalized Plants were more distributed than Floristic Specific Species Designed, confirming 84 Families 26 Species in the ponds and 9 Families and 26 Species in the small streams. Especially, *Ambrosia trifida*, *A. artemisifolia*, *Eupatorium japonicum*, *Aster pilosus* are pest plants that need prompt eradication. From the survey results as above, preservation experience using Floristic Specific Species Designated and removal experience using naturalized plant and pest plants are determined to be used in the future ecological experience.

Korea is involved with diverse traditional knowledge such as agriculture, oriental medicine, food, and art and crafts, based on plants in ponds and small streams. Through additional analysis on this traditional knowledge, additional production of guide books is needed to use ecological experience.

Trait composition of forest patches: Does spatial structure matter more than local conditions?

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The plant species composition of forest patches is thought to be partly determined by their spatial structure. For example, species with low dispersal ability are often considered less able to colonise small, isolated habitat patches. However the importance of spatial factors compared to local conditions such as soil quality and light availability is less well understood. We exploit a unique combination of national-scale habitat data and detailed information from small vegetation sampling plots in order to identify which aspects of forest patches are most important in determining their trait composition, and to quantify the relative strength of these effects. Through the use of historical map products we were also able to divide forests according to their age and investigate the ways in which the response of trait values to the spatial properties of forests differ in old versus young patches. Our results show that light availability and soil fertility often have the strongest effects on plant trait composition but that patch area and distance to edge of habitat also have a significant influence on a number of traits. We also found that trait values in older forests are more strongly influenced by the spatial properties of patches, with higher patch area in such forests leading to an increase in the occurrence of rare species with faster falling seeds and no persistent seed bank. This highlights the importance of large, older forest patches for the conservation of woodland plant diversity. Better understanding of the important aspects of forest patches for species with different characteristics will enable the important traits of species to be taken into account when modelling their response to changing landscape structure.

Field evidence for enhanced nitrogen partitioning in species-rich permanent grasslands

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Natural abundances of nitrogen stable isotopes in plant biomass can be used to trace the response of plants and plant communities to abiotic and biotic factors, providing insights into the value of biodiversity for ecosystem functioning. Community biomass is commonly used as a proxy of ecosystem productivity and respective nutrient concentrations are measured to assess the nutritional status of grassland ecosystems. However, although the community biomass may be a useful integrator for the characterization of the overall ecosystem response to environmental characteristics and changes, studies on patterns of stable isotopes in temperate grasslands have been mostly restricted to an experimental setup and only few investigations analyzed the isotopic composition of the biomass of species communities present in the field.

Here, we present a study on soil and community biomass d15N values from approx. 150 grasslands from three regions in Germany. Grasslands were arranged along a gradient of increasing land-use intensity that represent large parts of the Central European grassland vegetation, ranging from dry calcareous grasslands over mesotrophic grasslands, to silage meadows with several cuts per year. To correct for plot-specific differences in background soil d15N values biomass "Dd15N" values were derived plot-wise as the difference between foliar d15N and soil d15N. Multiple linear regressions were performed to analyze the effect of land use, plant functional group abundance, soil types, the kind of nutrient limitation and plant species richness on Dd15N of the grasslands under study. Results indicate that land-use intensity and particularly fertilizer application significantly increased the Dd15N signal, although the effect was less strong than expected. Plant functional group abundance, e.g. the cover of legumes revealed no significant effect on Dd15N, whereas biomass of fen meadows was significantly enriched in 15N and grasslands (co-)limited by phosphorous strongly depleted in 15N. Decreasing Dd15N values with increasing species richness showed that nitrogen acquisition in diverse grasslands is more effective and that losses via leaching or volatilization are relatively low. Our study of isotopic signatures across a broad range of agricultural grasslands revealed field evidence for enhanced nitrogen partitioning with increasing plant species richness.

A modern pollen-climate calibration set for tundra and northern taiga biomes from northern Yakutia (Arctic Siberia)

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The Arctic is expected to exhibit earlier and stronger responses to future global warming than other regions worldwide. Past variations need to be documented with high confidence to gain important insights in constraints and magnitude of predicted Arctic changes. Long instrumental records of climate are lacking for most Arctic regions, hence long-term climate information needs to be obtained from other sources, including the analyses of proxies in sedimentary archives like pollen records of lacustrine sediment cores. Detailed climate reconstructions from most regions in Arctic Siberia are lacking because a) necessary modern data sets are absent for many regions and samples were rarely collected from limnic sediments only, and b) most reconstructions lack a rigorous statistic evaluation.

This study aims to establish, evaluate, and apply a modern pollen-climate transfer function for the transition zone between arctic tundra and light-needled taiga in Arctic Siberia.

It is located in the northern Siberian lowlands of Yakutia and uses only lacustrine samples (n=96) collected along four north-to-south transects that cross the forest line. A broad temperature and precipitation gradient (mean July temperature, T.July: 7.5-18.7 °C; mean annual precipitation, P.ann: 114-315 mm/yr) is covered. Ordination analyses are used to examine the relationship between modern pollen signals and corresponding vegetation. Performance of the transfer functions for T.July and P.ann is validated and tested for spatial autocorrelation effects.

The validation resulted in root mean square errors of prediction of 1.67 °C for T.July and 40 mm/yr for P.ann. Applying the models to fossil pollen spectra from one lake sediment core within the Siberian Arctic yielded cold conditions for the Late Glacial period (1-2 °C below present T.July). Warm and moist conditions were reconstructed for the Early to Mid Holocene (2 °C higher T.July than at present), and modern climate conditions were reconstructed for the last 4,000 years.

In conclusion, our modern pollen data set fills the gap in regards to the under-represented tundra-taiga transition zone. Our Holocene climate reconstruction indicates that the Holocene temperature deviation from modern values was only moderate despite the assumed Arctic sensitivity to present climate change.

From meadow to shallow lake: Vegetation change after rewetting of a coastal brackish fen

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Rewetting of drained species-poor fen sites primarily aims at recreating self-regulating ecosystems with peat accumulating vegetation. In Northeast Germany rewetting measures often result in water levels above ground above ground due to peat compaction and mineralisation following long-term drainage. Such inundation is a heavily destabilizing force to the fen ecosystem and probably leads to a quick shift to helophyte-dominated vegetation.

We observed vegetation dynamics in a coastal brackish fen over one year before and three years following heavy rewetting and abandonment. We used a ground truthed remote sensing approach with medium-resolution aerial images in combination with annual plot-based vegetation data and a digital elevation model. This allowed us to characterize vegetation development both in terms of species diversity measures and patch metrics.

Inundation with water levels of up to 1.3 m above ground caused a massive dieback of existing Carex-dominated vegetation and formed open water bodies with characteristics of polytrophic shallow lakes. These are gradually colonized by *Phragmites australis*, *Bolboschoenus maritimus* and *Schoenoplectus terbernaemontani* in mostly monotypic stands with reduced patchiness in year two. Pre-existing vegetation and water table determined which of these species was favoured locally.

Niche specialization and community structuring of arbuscular mycorrhizal fungi in a temperate grassland on a local scale

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Natural communities are influenced by deterministic (niche) processes (abiotic and biotic factors) as well as neutral (stochastic) processes (dispersal limitation), which might all simultaneously influence species abundances. Most of the studies focused on microbial communities showed significant effect of deterministic as well as neutral processes in their structuring. Among soil microorganisms, arbuscular mycorrhizal fungi (AMF) play a fundamental role in many terrestrial ecosystems. As obligate symbionts of plant roots, the AMF mediate nutrient flow from the soil to the host plant, in exchange for photosynthetically assimilated carbon. The deterministic factors, such as soil structure and chemistry (particularly pH and macronutrient availability) seem to play very important role in AMF communities structuring. However, due to a tight coupling of the AMF life-cycle with their host plants, the diversity and structure of AMF and plant communities are also closely interlinked. In our study, we have chosen serpentine habitat as a model system for studding the relative contribution of deterministic (e.g. soil chemistry characteristics, host plant life stage, neighbouring plant communities) and stochastic (geographical distance) processes to AMF communities structuring at a local scale. We used DNA isolation from roots of *Knautia arvensis* (L.) J. M. Coult. (Dipsacaceae), followed by PCR with AMF specific primers (for ITS rDNA) and 454-sequencing. Altogether we detected 81 AMF MOTUs from most of Glomeromycota families. AMF richness declined linearly along the K concentration gradient, exponential declining was observed with increasing Cr concentration. Contrary, AMF richness linearly increased along pH gradient. AMF richness was also positively correlated with occurrence of *Veronica chamaedrys* and *Hypericum maculatum*, whereas the opposite was observed for *Avenella flexuosa* and *Galium harcynicum*. According to the Mantel test, variation in AMF community was significantly correlated with environmental factors (Mantel-r=0.278, p < 0.001), geographic structure (Mantel-r=0.175, p < 0.001) and marginally significantly also with neighbouring plant communities (Mantel-r=0.8, p = 0.056). Best model after step-wise selection of predictors of AMF community composition included locality, pH, life stage, serpentine character and Ni as significant explanatory factors, structuring AMF communities. We detected the most responsible MOTUs for each of the significant explanatory variable. Based on our and previously published results, we can hypothesize that the neutral processes play more important role in structuring AMF communities on local scale compared to regional scale, where deterministic processes dominate.

Comparing the effects on meadow succession of sowing site-specific and non site-specific grass species

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In grassland restoration seed sowing of matrix species is a frequently used technique to enhance the regeneration and the diversity of the restored sites. These seeds often come from non site-specific seed mixtures. In our experiment we compared the effects on meadow succession of sowing a grass species from commercial seed mixtures (*Lolium perenne*) and a species locally dominating the grasslands (*Festuca pseudovina*). We hypothesised, that the "local" grass can help to form a more species rich and more characteristic community than the one from commercial seed mixtures. The study site is a recently abandoned field near Tiszaalpár located in the Great Hungarian Plain and it is surrounded by sand and loess-steppe meadows. We monitored the assembly of plant communities in the treated and control plots. We examined the changes in dominance structure, diversity and species composition from 2009 to 2012, recording the abundance of species in 4 × 4 m relevés and in trainsects (1024 m) containing 5×5 cm relevés. Comparison of the results of the two monitoring techniques can help us to understand the fine scale processes underlying the development of the current species composition. The results showed us that sowing the highly competitive *Lolium perenne* remained in a species poor state through the first three years. In the fourth year the diversity increased in line with the drastic decrease of the cover of *L. perenne*. The diversity of the plots where *Festuca* was sown where the highest in the the first year, from the second year the diversity of the spontaneous (untreated) plots became the highest and increased permanently. Comparing the spearman's rank-order correlation of the plots showed that the dominance structure of the plots treated with *Lolium* where strongly hieararchical in the first two years of the experiment then - after the *Lolium* cover drastically decreased - this trend changed. As the *Festuca* tussocs strengthened the dominance structure of these plots became the most hieararchic from all treatments by the fourth year. The only plots where the regeneration process was similar to natural successional patterns where the control plots. Our results are in accordance with the previous studies showing that (in secondary succession) where there is no threat of spreading invasive species, we can rely on spontaneous succession as an inexpensive natural solution of restoring grasslands. We need to notice that during the time of the experiment traditional land-use types.

Small-scale patterns of plant biomass, soil nutrient content and abundance of microbes – what determines what?

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Small-scale heterogeneity of abiotic factors like soil nutrient content is expected to play a crucial role in determining plant productivity as plants are known to be able to concentrate their root biomass into areas with high nutrient content. At the same time, plant growth can also be largely influenced by the abundance of soil microorganisms. In particular, the abundance of arbuscular mycorrhizal fungi (AMF) can have great effect on plant growth as they can remarkably improve plants ability to acquire soil nutrients. Nevertheless, there is still little information about the small-scale distribution of soil nutrients, microbes and plant biomass. We asked: does the abundance of soil nutrients and/or microbes determine plant above- and belowground productivity?

We chose herb-rich old-growth boreonemoral spruce forest as a study site and collected samples of 15 cm diameter and 10 cm deep from the forest floor. From each sample, we determined soil nutrient content, microbial biomass (using phospholipid fatty acid content) as well as above- and belowground biomass of herbaceous plants.

The results showed that soil nutrient content as well as the abundance of soil microbes was variable. The abundance of AMF was negatively affected by soil phosphorus content and positively related to soil nitrogen content. At the same time, neither shoot nor root biomass of herbaceous plants showed any significant relationship to variation in soil nutrient content and the abundance of soil microbes.

Our study found no direct effect of soil nutrient content and abundance of soil microbes on the biomass of herbaceous plants, despite of the considerable variation in all of the factors considered. At the same time, soil nutrient content played important role in determining the abundance of soil microbes. The presence of AMF is expected to be more important for plants when soil nutrient (especially soil phosphorous) content is low. This was supported also by the reverse pattern of soil phosphorous and AMF found in this study. However, as plant biomass did not change despite of the changes in soil phosphorous content and in the abundance of AMF, our results indicate that plants can compensate for low soil phosphorus concentration via interactions with soil microbes, most probably due to more efficient symbiosis with AMF. Hence, it is crucial to consider both the soil nutrient content and the abundance of soil microbes when exploring the mechanisms driving vegetation patterns.

Poster D136

Can we use Ellenberg indicator values for environmental change assessment?

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Background: For decades, ecologists used differences in mean Ellenberg indicator values (EIVs) as a proxy for environmental changes.

Objectives: Here we used large dataset of semi-permanent plots with repeatedly measured environmental conditions and repeatedly sampled plant species composition to test if this approach is appropriate. Methods: We compared environmental changes calculated from measured soil reaction, nitrogen content, annual mean temperature and canopy openness with changes of mean EIVs calculated from plant species composition of the same plots.

Results: When compared within two sampled periods separately, mean EIVs correlated with measured environmental conditions relatively well. However, the changes in mean EIVs were not significantly related to measured changes in soil pH, nitrogen and temperature and only weakly related to changes in canopy openness.

Conclusion: Mean EIVs should not be used to infer environmental changes from repeated observations of plant species composition, because the changes in mean EIVs are driven by various factors not directly related to the environmental variables. Therefore, using mean EIVs instead of repeated measurements can lead to the misleading conclusions about environmental drivers of vegetation changes.

Density-dependent facilitation regulates population dynamics of herbaceous plants in a semi-arid Mongolian steppe

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Facilitation can regulate plant population dynamics by modifying spatial distributions of seeds and plants at micro-scales. We hypothesized that the magnitude and range of micro-scale plant-plant interaction effects changes according to the density of beneficiary plants. In drylands, mound-forming shrubs are considered to act as an ecosystem engineer by soil and seed trap under their canopies. To examine the density-dependent facilitation by shrubs on understory plant population dynamics, we addressed following questions; (1) how do shrub mounds affect seed immigration and plant establishment? and (2) do such effects extend over the shrub mounds with increasing shrub density?

In a desert steppe of Mongolia, seed immigration and plant establishment of three plant functional types (annual forb, perennial forb and perennial grass) were investigated at two shrub microsites (on- and inter-mound space) differing in the density (low and high) of legume shrub, Caragana microphylla. Shrubs promoted seed immigration and inhibited plant establishment on the mounds compared with those in the inter-mound space for all the functional types. The plant establishment of annual forbs in inter-mound space was enhanced at high shrub-density sites with increasing seed immigration. In contrast, the plant establishment of perennial forbs and grasses was inhibited even in inter-mound space at high shrub-density sites, probably by soil accumulation.

Shrubs strongly regulated the population dynamics of herbaceous plants by causing conflict of distribution between seeds and plants at micro-scale. Such shrub-induced effects density-dependently expanded from on-mound to inter-mound space, and enlarged species-specific responses. Micro-scale facilitation can play an important role in structuring plant communities at a landscape scale via density-dependent variation in plant-plant interaction.

Poster A47

Different pathways of drained fens development – the influence of management and nutrient dynamics on vegetation

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Most of the temperate European fens have been influenced by drainage for agricultural purposes. Drained fens support a broad range of ecosystems both species poor and species rich. Within the presented study we attempted to identify the main factors influencing vegetation development and species richness of the non-forest vegetation of drained fens.

During the growing seasons of 2011 and 2012 we collected 39 samples within 25 peatlands spread over a large area in northern Poland between 16 and 23°E and 52 and 55°N. Apart from the vegetation we sampled soil parameters (peat oxidation depth, pH, ash content, calcium, potassium and iron content). We also determined the primary productivity of vascular plants, management (mowing) intensity and nutrient limiting primary productivity based on the nutrient ratios of the aboveground vascular plant tissues.

The analysis of species composition identified four main vegetation units: meadows with endangered species from the "litter meadows" (*Molinion* alliance); typical species-rich fen meadows; dry, species-poor meadows with *Festuca rubra* and *Anthoxantum odoratum* and nirophilous tall-herb vegetation. The species richness of the sampled sites varied from 7 up to 38 species per 9 m^2 and the primary productivity from 87 to 1226 g/m^2. There was no significant effect of productivity and management on species richness. Only a slight negative effect of peat oxidation depth on biodiversity was noted. Low management intensity distinguished tall herb vegetation and shallow peat decomposition prevailed within the fen-meadow communities. The soil parameters did not influence either species richness or composition. Limiting nutrient differed between the vegetation units. Meadows with "litter-meadow" species were the group exhibiting strongest phosphorous deficiency. Whereas species poor dry meadows were limited by potassium. In the case of the fen-meadows and the tall herbs the limiting nutrient was nitrogen.

The results revealed that the degradation phase and drainage intensity were not the only factors influencing community richness and structure within the drained fens. The influence of the type of nutrient limitation of primary productivity on determining the community structure and richness was emphasized in the present study. The above factor has to be taken into account in management and restoration schemes referring to drained fens.

The Vegetation of Island Arcs as a Biogeographical Phenomenon

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The study addresses the historical role of East Asian island vegetation and the related consequences of climatic fluctuations in the development of modern regional biodiversity. The main goal is to clarify the influence of continental biota on the formation of island vegetation under different climatic conditions at the different historical periods and to explain how the species of island floras may have adapted to the changing conditions of the island environment. A unified database of the flora and vegetation of the Aleutian, Kuril and Japanese archipelagos, enabled a comparison to be made between regional Asian floras and island floras in general as well as species composition of the vegetation units representing alpine tundras, subalpine shrubs and forests. A new digital vegetation mapping algorithm with greatly improved accuracy in mapping real vegetation complexes at the landscape level, considerably simplified the process of creating maps of potential vegetation. Bioclimatic models were developed for vegetation of key areas in islands and mainland Asia. During the Pleistocene and Holocene the island arcs and the Kamchatka Peninsula represented a significant refuge for amphipacific humidity-dependent species, and this significantly influenced vegetation development of the Far Eastern continental margin. The developmental patterns of the flora and vegetation in the island arcs are clarified through examination of Aleutian and Kuril Islands data accumulated over 250 years. From this it can be shown that the history of Aleutian and Kuril vegetation during the late Pleistocene and Holocene is consistent with a successional pattern of (1) active migration in conditions of oceanic climate and the availability of land bridges (2) regression of many species due to climate cooling, and (3) activation of secondary migration under conditions of climate warming and sea level rise. Volcanic activity characteristic of the Kuril and Aleutian Island arcs, combined with a harsh oceanic climate, even in the era of marine regression, acted as a filter, restricting plant forms that usually characterize continental climax communities and thus resulting in species with well a expressed rural strategy, which have now formed extensive seral communities on the zonal island habitats.

Can Ellenberg indices explain long-term vegetation change?

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Ellenberg indicator values (EIV) represent certain ecological requirements of central-European plants. Their weighted averages in the whole community or ecosystem should therefore link to certain environmental conditions. Several studies already linked vegetation change to environmental change at shorter time scales of several decades given the present-day evaluation and validation of EIVs. However, could EIVs be used for long-term vegetation studies spanning several millennia?

Palaeoecology of past interglacials provides unique opportunity to study long-term vegetation changes unaffected by humans and other disturbing factors such as abrupt climate shifts. Use of EIVs might enable testing of a hypothesis that soil development is one of the main driving factors of vegetation change during these periods. Moreover, models based on pollen dispersal characteristics allow spatially explicit vegetation reconstruction from pollen records. We used REVEALS model to reconstruct regional vegetation for past four interglacials and based on that we calculated time-series of EIVs. Trees possess different mycorrhizal types for nutrient acquisition, therefore we also evaluated ratios of these mycorrhizas in reconstructed vegetation.

Results show a consistent pattern in EIVs trends for all interglacial time series independent of vegetation types. EIV for N and R show initially high values peaking in the first third of the interglacial followed by a slow long decline. Composition of trees with arbuscular mycorrhiza is the highest at interglacial's start decreasing towards interglacial's end.

As EIV N has been shown to work as a proxy of productivity of the ecosystem, we conclude that interglacial's productivity reaches maximum during the first third of the entire period at the time, when forests are most dense. Plants with arbuscular mycorrhiza indicate easily accessible phosphorus in soil than e.g. ectomycorrhizal plants. Combination of EIV N and ratio of arbuscular mycorrhiza is used here to define content of nutrients in soil, which is decreasing towards the end of interglacial together with increasing soil acidity (R).

I conclude that EIV can be successfully used to explain long-term drivers of vegetation change. Soil development was more important during interglacials than climate, which is yet illustrated on the previous interglacial on a combination with calculated rate of change. The overall pattern during the Holocene is different due to human impact, which caused abrupt shift with agriculture practises and was probably extensive already during the early postglacial.

Holocene history of Siberian larch (*Larix sibirica*) at its western range margin in Russia

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Background The Siberian larch (*Larix sibirica*) has a significant role in boreal forests across the taiga zone in Russia. The modern western range limit of the species is located east from Lake Onega in Eastern Russian Karelia. Understanding of the occurrence of Siberian larch and the drivers of boreal forest dynamics at the species western range margin could increase knowledge of the development of boreal forests during the Holocene.

Objectives To investigate the Holocene presence of the Siberian larch at its western range limit in Europe and statistically examine the predictors of long-term boreal forest dynamics based on small-hollow records from the modern western margin of the Siberian larch in NW Russia.

Methods Pollen and stomata analysis from small forest hollow sites are applied to investigate the Siberian larch and boreal forest dynamics during the Holocene. Stomata records provide reliable evidence of the in situ presence of the conifer tree species. Particularly larch stomata are more abundant and identifiable than larch pollen, and when analysed from small hollows within the modern larch stands, can produce more reliable evidence for past occurrence of Siberian larch. To detect the predictors of boreal forest dynamics we apply regional climate data generated from climate model, microscopic charcoal data as proxy for local fires and peat humification data as proxy for local peat surface wetness. The forest composition is derived from pollen dataset including eleven most abundant pollen taxa. Redundancy analysis (RDA) and variation partitioning is employed for statistical analysis.

Results The cores cover the last 10 000 years of the Holocene. Larch stomata are abundant and first larch pollen and stomata are found ca. 9 000 cal yr BP. Spruce (*Picea abies*) pollen and stomata were also found throughout the cores and the pollen records show expansion of the spruce population ca. 8 000 - 7 000 cal yr BP. The charcoal records from each small hollow site are different, but all show decreasing fire frequency during the spruce maximum.

Conclusion Pollen and stomata records from the small forest hollows indicate that boreal trees have been present near the sites already from the early Holocene. The results suggest that Siberian larch has been present at its western range since ca. 9 000 cal yr BP and that western range limit of the species in Europe have presumably remained constant since the early Holocene.

Exploring the impact of uncertainty in species distribution limits on modeling the spatial distribution of tree species in northern Europe

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In an era of accelerating global change the outcome of models is used to form our understanding about future biodiversity changes. Assessing inherent uncertainty is therefore urgently needed to evaluate the validity and applicability of model simulations. A major source of uncertainty in contemporary modeling approaches constitutes our limited knowledge about species' fundamental niches, i.e. where species could live and reproduce without any limitation by biotic interactions. In the absence of this information, it has become common practice to use species current distributions in environmental space to project species distributions under scenarios of climate change. Species current distributional limits, however, are only a snapshot emerging as a result from a complex interplay of past and current environmental factors and networks of species interactions. Furthermore, various additional sources of uncertainty are often associated with species distribution limits resulting from, for instance, coarse and/or different resolutions of climate and species distribution data, incomplete sampling, land use history and source-sink dynamics.

Knowledge and understanding of the impact of these uncertainties on model simulations is currently lacking. Here, we present a highly innovative approach to investigate this impact on model simulations of the dynamic ecosystem model LPJ-GUESS. LPJ-GUESS provides a straightforward platform to explore this question, because it combines process-based formulations of plant physiology and ecosystem biochemistry with dynamic aspects of plant species competition to simulate plant species performance within a set of predefined bioclimatic limits. Using sensitivity analysis we explore the impact of uncertainty in these limits on modeled vegetation patterns based on dominant temperate and boreal European tree species. In the absence of knowledge about the true limit, we implement an uncertainty range of the species' distribution limit. We demonstrate the emergent spatial patterns of the vegetation and identify regional differences in the robustness of the simulations. Preliminary results highlight distinct spatial patterns of uncertainty in model simulations. Finally, we discuss the implications of these findings for our confidence in simulations under scenarios of climate change.

Vegetation succession and species immigration in a newly abandoned limestone quarry: spatio-temporal patterns on a small scale

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The availability of a plant species source is known as the key factor influencing the course of vegetation succession in man-made habitats. In case of abandoned limestone quarries, vegetation present within 100 m seems to serve as an effective species source. However, deeper understandings of the spatio-temporal patterns of species migration from source to a new-made habitat are still needed, especially because of their applicability in management and restoration of human-disturbed areas. We studied the initial three years of spontaneous succession in an abandoned limestone quarry in the Czech Republic with an aim to describe the small-scale patterns of plant species migration from valuable dry grassland which is situated next to the quarry. We asked following questions: 1) What are the changes in species diversity and composition during three years of succession? 2) To what extend do species from adjacent grassland participate in the succession? 3) Does the participation of dry grassland species vary over time and with distance from the species source?

We used repeated phytosociological sampling of 30 permanent plots (1 × 1 m), distributed into a 50×100 m rectangle net. We observed changes in species diversity and vegetation composition over time and space. With knowledge of surrounding vegetation we observed also the spatio-temporal patterns of small-scale migration of species from the adjacent dry grassland.

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 metres 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 plant migration from a species source can affect vegetation development on a small spatio-temporal scale. Sites closer to the species source seem to have higher probability of colonisation: in our case, sites within 20 m from the adjacent grassland. 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.

Poster E175

Impacts of forest management measures on plant species diversity in EU Natura 2000 habitats

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Natura 2000 is a coherent ecological network of special areas, designated under the EU Habitat Directive (1992) and EU Bird Directive (1979), to preserve biodiversity and habitats in a favourable conservation status. Within the Natura 2000 network in Slovenia, managed forests dominate, and conflicts between nature conservation and timber productive roles are possible.

Forest management is a robust driver of diversity and, according to the applied options, may act as a factor of enhancement or depletion of biodiversity. In the framework of the Life+ ManFor C.BD project, within the Dinaric fir-beech forest in Slovenia, the impacts of three key factors (forest management, dominant tree species, and location) on plant species diversity have been studied. Besides their significant forest-management and timber productive role, their ecological and nature-conservation aspects are also important. These forests are the central parts of the habitats of three large European predators, the brown bear, lynx and wolf, and of many other species of nature-conservation interest, and the major part of these forests has been designated as part of the Natura 2000 network. According to climate change predictions, they might be also among the most threatened forests in Slovenia in the future. To mitigate the effects of climate change on these forests and to preserve the present biodiversity, appropriate forest management measures need to be applied.

The plant species diversity has been tested before and will be assessed after implementation of forest management measures of three intensities (control without any measures, 50% and 100% of present growing stock will be felled). In this article, the status of plant species diversity before the implementation of forest management measures is presented. In three selected sites, 27 plots were set in the bottom of the karst terrain depressions (sinkholes). Among three groups of plots with different planned forest management measures and among three groups with different dominant tree species, there are no significant differences in the plant species diversity parameters. However, there are significant differences among groups of plots from different locations of Dinaric fir-beech forests.

The number of species per 400 m² sized plots varies between 29 and 68 (mean: 48.8), and the value of the Shannon diversity index H' is between 1.23 and 3.30 (mean: 2.41). After the implementation of forest management measures, the plant species diversity will be assessed in order to optimize forest management system in these sensitive forests.

Poster E161

Functional groups as helpful tools for grassland conservation

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Species richness and diversity indices, typically used as biodiversity surrogates, are increasingly being questioned in connection to their inferential potential on habitat quality, while functional groups are gaining momentum in supplying synoptic information on community structure.

We explore the usefulness of functional groups to provide insights on plant community characteristics in grassland habitats of conservation value. For this purpose, surveys were performed within 30 linear 80m transects in Alta Murgia National Park (southern Italy) during March-September 2012. Records of abundance/dominance of herbaceous plant species and information about grass cover and height were taken, respectively representing response and independent variables. The latter were considered as proxies for the relative degree of plant community preservation. Species were classified in several groups, according to their specific life form, chorology and role within principal syntaxa; values of species richness and abundance were then estimated for each group and used to calculate values of Shannon's diversity index. All variables were tested with bivariate correlation analysis. As expected, overall plant richness and diversity are not clearly related with better preserved plant communities, while correlations with functional groups associated indices seem more informative. Among selected functional groups, life forms provide significant inferences about vegetation structure, when considering abundance values, and ecological traits, when considering richness values, while life form diversity index is associated with perennial and well structured communities. Chorotypes give details on some climatic and anthropogenic features, e.g., allowing the discrimination of variations in thermic conditions or grazing pressure and the identification of features of biogeographic concern. Characteristic species of syntaxa improve information about community dynamics of succession and distribution. Thus, it is clear that information provided by each functional group is relevant to specific community patterns. This is to be taken into account when selecting indicators of habitat quality, as an integration of their inferential potential is necessary both for the definition of local conservation actions and for habitat monitoring by means of remote sensing techniques.

The influence of tree canopies on soil nutrients and understorey species composition in an African savanna

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It is well know that tree canopies have an influence on the soil and species below them. However the details of the influences may be species specific or related to the life form of the tree. This study compares the soil nutrients and understorey composition of a resprouter, non nitrogen fixing species (*Euclea divinorum*) and a nitrogen fixing fire-killed tree (*Acacia nilotica*) from the southern African subtropical savanna.

Sampling of the plants and soils was conducted at 1m intervals along 15 m transects from the base of six *Euclea* and six *Acacia* trees with canopies of 5 m radius on relatively level ground in Hluhluwe National Park (Kwazulu/Natal) in South Africa.

Nutrient levels were higher under the tree canopies than in the grassland beyond the tree crowns. However nitrogen levels were similar in the soils beneath the two species despite the lack of nitrogen fixing capacity in *Euclea* and the lower levels of N in the leaves of *Euclea* than in *Acacia*. This was similar for phosphorus and potassium but calcium, sodium and magnesium levels tended to be higher under *Euclea* than *Acacia*.

There tended to be more species of shrubs under the tree canopies and fewer species of grasses and herbs than in the areas outside the canopy. Species that tended to be more frequent under the canopy of *Acacia* were *Panicum maximum*, *Chloris gayanum* and a *Solanum* sp., while under *Euclea Dactylocentrum australe* and *Justicea flava* were more frequent than outside. Outside the canopies the grasses *Digitaria sanguineus*, *Eragrostis superba*, *Sporobolus pyramidalis*, *Themeda triandrus* and *Bothriocloa insculpta* were more prominent than under the canopies.

Euclea is more permanently located in the landscape than *A. nilotica*, as it can resprout after fire, and seems to build up a greater store of nutrients such as Mg, Na and Ca in the soil than the less permanent acacia. However this is not the case for nitrogen, phosphorus and potassium.

The project WetVegEurope: formalized classification of European aquatic and marsh vegetation

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The need of an internationally standardized and clearly formally described classification of vegetation is widely recognized among European vegetation scientists, especially in the context of nature conservation policy. However vegetation classification, traditionally accepted in different European countries, has been developed using different methods, approaches and criteria, which are often not explicitly formalized.

WetVegEurope is a project launched in February 2013 by the European Vegetation Survey (EVS), Masaryk University (Brno, Czech Republic) and University of Perugia (Italy). The aim of this project is to realize the first European synthesis and formalized classification of freshwater aquatic vegetation (classes *Lemnetea* and *Potametea*) and marsh vegetation (class *Phragmito-Magno-Caricetea*) to the level of phytosociological associations.

This work is based on a large set of phytosociological relevés collected across Europe, mostly extracted from national, regional or thematic databases. A formal definition will be developed for each association using the Cocktail method, which is a supervised classification method designed to imitate the Braun-Blanquet approach, combining expert knowledge and numerical data analysis. The project also aims to characterize each association in terms of ecology, distribution and nature conservation status. The whole classification scheme will be implemented in a computer expert system for automatic identification of vegetation types based on relevés.

At the moment representatives from most of the European countries joined to the project and provided data. Although the project is still in an initial phase, preliminary results about vegetation types and their distribution across Europe can be shown and discussed.

Plant communities of native plants after invasion of non-native shrubs

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Invasion of non-native plant species may have ecosystem-wide effects and seriously threaten biodiversity. It remains unclear whether the origin of the invading plant plays a marked role for ecological consequences of an invasion process as only few studies have compared the ecological impacts of non-native shrub species with structurally or functionally comparable native shrub species.

A study was conducted in south-western Finland to assess whether there are general differences in plant species richness and composition of native herb assemblages at patches formed either by non-native or by native shrubs. To shed light to the mechanisms behind the differences in herb assemblages, we also studied biomass production, light environment and soil conditions in the non-native and native shrub stands. To test whether the results obtained from our intensively studied model system can be generalized to a wider group of bush species, we inspected the plant species composition in an additional 80 shrub patches belonging to 24 species of four plant families, occurring within the study region.

Species richness and biomass production of herbaceous plants were lower in patches of non-native than in native bushes leading to obvious differences in non-native and native herbaceous assemblages. The amount of litter was higher below non-native than native bushes. Origin of the shrub (non-native vs. native) did not explain variation in soil nutrients, neither the production of shoot biomass or allocation of growth to different parts of the shoot. The amount of light reaching ground level did not differ between patches of a non-native and a native bush.

Our results suggest that the origin of the patch-forming plant may have a large effect on the diversity and composition of associated herbaceous vegetation. However, resource availability and light conditions inside bushes are not sufficient indicators to explain negative effects of non-native shrubs on plant communities. Further research is thus needed to investigate whether alternative explanations, such as the novelty of the toxic compounds produced by non-native plants, can clarify the differences we observed.

Functional niche overlap promotes species richness through equalizing effects in limestone grasslands: evidence from within-, between- and total functional diversities

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§ Relating variations in species richness to functional niche overlap between species may provide a useful test for evaluating alternative community assembly theories.

§ Three plant functional traits (height, SLA, LMDC) were measured on more than 1600 individuals of species coexisting across sixteen limestone grasslands. Using single and multi-trait approaches, we tested the relationship between functional niche overlap and species richness by disentangling functional diversity components within communities (within-, between-species and total diversity) and by considering potential direct and indirect effects of multiple soil properties.

§ Although the within-species functional diversity only ranged between 13.5% and 33.6% of the total functional diversity, it was the main driver of variations in species richness. Species richness increased with greater niche overlap supporting the existence of equalizing mechanisms allowing species to coexist. Our results also suggested that both the soil properties and niche overlap acted together, but independently, on species richness.

§ Our results provide evidence that niche overlap, instead of niche differentiation, can promote species coexistence. We also demonstrated that disentangling multiple functional diversity components within communities, while taking abiotic effects into account, is needed to better detect underlying processes structuring plant communities.

Key-words: abiotic environment, functional diversities, mechanisms of species co-existence, niche overlap, single and multi-trait approaches, species richness.

Identifying biotic interactions to model species distributions

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Studies of species range determinants have typically focused on abiotic variables (traditionally climatic conditions), and therefore the recent explicit consideration of biotic interactions represents an important advance in the field. While these studies provide clear support for the role of biotic interactions in controlling species distributions, most examine only the influence of a single species and/or interaction, the choice of which is based on partial *a priori* knowledge of the ecological system. Here we test 1) if all biotic interactions which are assumed to be important need to be included in species distribution models (SDMs), and 2) if unrecognized influential interactions can be identified under data-limited conditions. To do this, we analyse two large datasets (n = 960 and 1080) comprising 1 m^2 quadrats in alpine tundra in north-western Finland and Norway.

First, by fitting SDMs, we examine the influence of multiple vertical (grazing, trampling and manuring by mammalian herbivores) and horizontal (competition and facilitation; estimated from the cover of dominant plant species) interspecific interactions on the occurrence and cover of 41 plant species. Adding plant-plant interactions to baseline SDMs (based on five field-quantified abiotic variables) significantly improved models' predictive power, while herbivore-related variables only had a weak influence. Second, we demonstrate a novel method for distinguishing important biotic interactions from spurious spatial associations (i.e. species that share common requirements for unmeasured habitat characteristics). This is done by sequentially characterizing the improvement of SDMs for 215 vascular, bryophyte and lichen species after the incorporation of 44 potentially-influential dominant plants. Subsequent analysis of the accuracy of predictions of dominant species cover allows these species to be split into three categories: strong direct influence, indirect influence, or weak influence on other species.

Thus, explicit consideration of multiple biotic interactions reveals that plant-plant interactions exert control over the fine-scale distribution of vascular species that is comparable to abiotic drivers and considerably stronger than herbivores in this low energy system. Furthermore, we can now identify which other plant species may have an important role in shaping species distributions, and should therefore be examined when modeling species occurrence patterns.

Plant dormancy and metapopulation dynamics

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It has been stated that the applicability of metapopulation theory to describe the regional dynamics of many plant populations is limited because metapopulation theory has not given general insight about the impact of dormancy on metapopulation dynamics. Local plant populations may persist through long-lived life history stages such as vegetative ramets or dormant seeds when they are not demographically active and do not produce emigrants, and dormancy has often profound effects on local population persistence. Many other organisms, for instance daphnids, other crustaceans, tardigrades, and fungi also have dormant stages that play an important role in population dynamics. I constructed simple metapopulation models that included dormancy and dynamics of patch suitability as pulse disturbance or longterm destruction. The models show the quantitative relationship between colonization and extinction rates and likelihood of population recovery from dormancy. I also applied empirical data to estimate model parameters to describe and predict regional dynamics of two plant species with patchy populations and seed bank.

Opposite functional strategies along succession caused by different environmental stressors between a recovering temperate and subtropical forest

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Background: There has been great advancement in understanding how communities change in species along succession in recovering forests worldwide. What is greatly lacking however is understanding how traits, representing functional strategies, change along succession in temperate and tropical forests having different environmental, climatic, disturbance and evolutionary histories.

Objectives: To investigate functional changes along a succession chronosequence in a red pine-mixed deciduous forest of northern Ontario, Canada (11 spp/ha) and a subtropical *Araucaria*-mixed forest of southern Brazil (124 spp/ha).

Methods: Using community-weighted trait means we performed trait selection analysis identifying traits that converge or diverge in each forest along succession (log-basal area). We tested significance of convergence and divergence patterns of selected traits using Procrustes congruence (10,000 permutations) in the program SYNCSA (V. Pillar). We identified whether selected traits, and functional diversity (Rao quadratic entropy) converged or diverged through linear regressions of trait means along succession.

Results: Traits showing maximum convergence and divergence with logBA were max height, leaf nitrogen and proportion deciduous for the temperate forest (P=0.026) (all greater variance during early succession). Subtropical forest traits selected were SLA (specific leaf area), proportion zoochory (greater variance early succession) and leaf nitrogen, wood density (greater variance late succession) (P=0.05) (two forests pooled: P=0.16). Trait mean regressions with logBA showed opposite patterns in structural traits along succession: temperate forest max height increased while wood density decreased (birch, hardwood maple and oaks -> red and white pine), whereas wood density increased in the subtropical forest but max height showed no trend. Leaf trait responses also showed opposite patterns along succession as leaf nitrogen and proportion deciduous decreased for the temperate forest whereas they increased for the subtropical forest. Functional diversity along succession was positively linear (P<0.001) for the subtropical forest but unimodal for the temperate forest (P<0.001). Functional diversity of subtropical mature forest was 33% higher than temperate mature forest (P<0.001) (no difference between young forests (P=0.31)).

Conclusion: Succession in Canada represents a novel process of southern species, adapted to warmer climates (larger, deciduous leaves) encroaching pine forests further north (perrenial needles). Despite opposite leaf nitrogen and wood density patterns along succession, values among the forests were similar, along with BA/ha. This identifies common constraints in several trait value ranges (structural, nutrient) yet unique functional trait strategies in each forest along succession.

Assessing the relative importance of methodological decisions in classifications of vegetation data

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For hierarchical classification of vegetation data, researchers have to choose from many alternatives regarding the range of plot sizes involved in the analysis, the transformation of abundance values of species, the resemblance measure, the clustering algorithm and the number of groups to be interpreted. Since no universally valid criteria are available, all decisions remain arbitrary in every step of the study. Although all the above-mentioned factors affect the result, vegetation classifications are not equally influenced by them, and differences are always case dependent. In this regard, the evaluation of the relative importance of decisions influencing the classifications may be extremely helpful. We use an actual data set from dolomite grasslands and randomly simulated data as well to partition variation in the results attributable to plot size, data type, resemblance coefficient, hierarchical clustering strategy and to the number of clusters.

The grassland data set consisted of series of plots with spatially nested arrangement, and the simulated data set was designed to mimic this structure. Both data sets were resampled to obtain 200-200 matrices, each matrix containing one plot from each location of the grassland or the simulated data set.

The matrices served as input for a 'standard' classification procedure. Decisions regarding the plot sizes in the matrix, data transformation, resemblance measure, clustering algorithm and cluster number were made randomly. Then, variation between classifications (partitions) was analysed by distance-based redundancy analysis with methodological decisions as explanatory variables.

Mean plot size always explained a significant amount of variation, especially when simulated data were analysed. For the grassland survey, data transformation and clustering algorithm were the most important explanatory variables. SD of plot size, resemblance measure and number of groups accounted for less variation.

The results showed that the choice of plot size is always a key issue in classification studies. In lieu of biological pattern in the data, difference in plot size can easily produce artifacts. If certain biological patterns are present, data transformation and clustering algorithm may have stronger effect than plot size, however, but the latter is still significant.

Poster D122

Interspecific variation in plant responses to genetic relatedness of neighbours

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In competition for limiting resources, plants often adjust their morphology and biomass allocation to competitive organs in an attempt to maximise their resource uptake while denying resources to neighbours. Individuals of many plant species may frequently encounter neighbours that are genetically very close or identical to themselves. In such situations, avoidance of direct resource competition should be favoured as it would increase a plant's inclusive fitness. Kin recognition and avoidance of competition between siblings has been demonstrated in several species, but it is not clear how widespread this behaviour is. In the current study, we investigated the ability of eight co-occurring plant species to distinguish between sibling and non-sibling neighbours and to avoid competition with close relatives. Clear sibling recognition and cooperative behaviour towards siblings were only observed in *Trifolium repens*: with increasing neighbour density, plants grown among siblings significantly increased investment to seed production at the expense of allocation to competitive organs, while plants grown among unrelated individuals did not display such a response. In natural conditions, *Trifolium repens* produces numerous clonal offspring, which can form monoclonal patches. Therefore, individuals of *T. repens* frequently encounter genetically identical neighbours. For such a species, it may be beneficial to recognize close relatives and to compete with them as little as possible. One more species (*Lychnis flos-cuculi*) exhibited differences in specific leaf area in sibling and non-sibling groups, but other traits remained unchanged. The effect of genetic relatedness on plant traits always depended on neighbour density. In summary, our results suggest that kin recognition may not be a common phenomenon in temperate grasslands and that responses to the genetic relatedness of neighbours are highly species-specific and may depend on the species' growth form and reproductive strategy.

Biotic and abiotic effects on species and community functional trait composition: lessons from a grassland experiment with dominant removal

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There have been many attempts to analyze the relationships between community trait composition and environmental conditions or land use types. However little is known on the effect of the dominant species on the functional structure of communities. Further, the response of communities, with potential effects on ecosystem functioning, can be caused by both species turnover and intraspecific trait variability, while only first is generally assessed. In an experiment in an oligotrophic wet meadow (Molinion type), we combined fertilization, mowing and removal of dominant species *Molinia caerulea* in a factorial design.

The development of the plant community was followed for nearly two decades, and most of the trait information was measured, for most of the species, under different experimental treatment combinations. Both mowing and fertilization had pronounced effect on species composition, species diversity, functional composition and functional diversity. For example, both mowing and fertilization increased the abundance of grasses, whereas the forbs and graminoids were more abundant in unmown and unfertilized communities. Also, both fertilization and mowing affected the community weighted mean values of individual traits, but also the values of traits differed among treatments within species. Plant potential height was the best predictor for the species response to mowing and fertilization. The genuinely tall species are less abundant in mown, and more abundant in fertilized plots. The positive effect of fertilization on tall species is explained by switch from competition for nutrients to competition for light with increased nutrient availability.

The dominant species *Molinia caerulea* was most abundant in unmown unfertilized, and less abundant in mown fertilized plots. Accordingly, effect of its removal was most pronounced in unmown unfertilized plots. There, it was replaced mostly by forbs, i.e by phylogenetically and functionally different species. Also, *Molinia* removal caused changes in some emergent community properties - e.g. the time of seasonal biomass peak is shifted toward earlier date in removal plots. Presence of the dominant increased the amount of slowly decaying litter in the community, suppressing seedling establishment. The results support the idea that constituent species identity, and composition of species functional traits are the fundamental determinants of plant community functional structure, and species traits are good predictors of species response to both abiotic and biotic filters. Finally, neglecting intraspecific trait variability across habitats often results in underestimating the response of communities to environmental changes.

Poster A7

Identifying land-use change impacts on plant community and functional composition of a globally rare semi-natural grassland

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Certain habitats, [e.g. semi-natural grasslands (SNGs)], have shown substantial resistance to climate change, but are sensitive to changes in land-use management. Here, using large-scale spatial temporal data, we investigate how land-use change may be impacting plant community and functional composition, and overall biodiversity of a globally rare SNG (Machair). The aim of the study was to identify national- and regional-scale temporal vegetation patterns, and relate them to drivers of change to highlight regions of conservation concern. Shifts in plant functional signatures (i.e. CSR and Ellenberg) identified varying degrees of internal (competition) and external (land-use) factors, highlighting several regions where biodiversity change can be linked to either reduced disturbance, particularly grazing intensity, or more intensive disturbances. Regions displaying increased diversity, moreover an increase in species indicative of good quality Machair grasslands, are shown to be those regions once designated as Environmentally Sensitive Areas, and highlight the value of government incentivised schemes to support extensive, traditional, low-intensity land management.

Partitioning Beta Diversity: Investigating temporal patterns of richness and replacement components for a rare semi-natural grassland

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Two distinct components of species dissimilarity are species replacement and species richness differences. These components are attributable to two very distinct ecological processes: (i) an imbalance in recruitment and extinction (richness differences), and (ii) a substitution of one species with another (replacement). This study takes a multi-model and multi-index approach to investigating temporal species dissimilarity among semi natural grassland communities of Scotland. We test if climate and spatial turnover explains temporal patterns among plant communities, and ask whether climate equally explains species richness and replacement components of beta diversity.

We use separate measureable components i.e. mean, variance, slope, auto-correlation and fat-tails of three important climatic parameters (i.e. temperature, water balance and growing degree days) known to influence spatial and temporal turnover among plant assemblages. Models were run including and excluding spatial turnover to gauge its contribution to temporal turnover. Several measures of β-diversity were used, each representing different measurable component of turnover, (i) species richness difference component (βgl), (ii) species replacement components (βsim), and (iii) combined richness and replacement (βsor).

Results suggest climate to have a small, yet significant influence on temporal turnover patterns. The response of turnover to different measurable components of climate was found to vary depending on the turnover index used, that is, it depended on the component of turnover examined. Both temporal change in climate and the extent of turnover were found to vary in space. Spatial turnover was shown to significantly enhance a models capability of capturing temporal variation using different indices of turnover. In summary indices measuring separate components of turnover (richness gradients and species replacement), can show contrasting responses to different aspects of climatic variation; these patterns can be dampened when using an index that captures both components simultaneously. Partitioning temporal patterns of beta diversity through a multi-metric approach allows greater insights into the processes that maintain biodiversity as substitution and loss of individuals are patterns that can derive from completely different processes. This can provide relevant information for conservation management that may not become evident from classical studies that utilise single metrics of beta diversity.

Chamaecyparis forest in Taiwan

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There are six species of Chamaecyparis in the world. These species distribute in North America and East Asia. All of them require a kind of cool, humid and foggy habitats in these regions. Only two of the six species, C. formosana and C. obtusa var. taiwanensis, are in the subtropical mountain region, Taiwan. Chamaecyparis forest in Taiwan is featured by the large trees, multiple-layer structure and highly diverse epiphytes on the trunks and herbs on the ground due to the cloud formation and soil condition. There are still large areas of pristine Chamaecyparis forests remain in the remote mountain region in Taiwan. In this study, we used National Vegetation Database of Taiwan to describe the floristic composition of different Chamaecyparis forest in Taiwan and their possible explanatory environmental variables. Land surface temperature and soil moisture index derived from satellite imagines are the main factors influencing the accompanied woody species among Chamaecyparis forests while the topography which indicates soil condition is the main factor influencing the herb species composition. Spatial structure derived from Principle Coordinates of Neighbor Matrices (PCNM) can explain the beta diversity of Chamaecyparis forests well. This spatial structure might be caused by the spatial structured environmental factors such as cloud and soil chemistry which are not measured in this study or the longevity of the species and their special regeneration regime.

Evidence for edge effect on black alder woodland key habitats in Latvia

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Black alder woodland key habitats are protected under the Habitats Directive (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora) in European Union. In Latvia, the gap analysis of woodland key habitats shows serious lack of this habitat type in all regions. The aim of this study was to estimate the edge effect impact on the vegetation of black alder woodland key habitats. The study area was situated in central region of Latvia - in Zemgale. The research has been performed in two forest types on wet peat soils: Dryopterioso-caricosa and Filipendulosa. In total, 30 study sites were arranged and surveyed (the area of each sample plot is 20 × 50 m), which has been divided into five 10 m wide sample zones. In the south side of the study sites there are stands that correspond to 3 different age groups: young forest stands, middle age forest stands and mature forest stands (in each group there are 10 study sites). The Braun-Blanquet method was used to describe the plant communities: the total projective coverage of moss, herb, shrub and tree layer as well as the coverage of each separate species was evaluated in the sample zones in percentage. In order to assess the influence of edge effect, average ecological values of vascular plants were calculated, and analysis of classification and ordination were used. In total, 150 vascular plant species and 41 bryophytes were found. The study shows that the richness and composition of species differ among the zones and different age classes, and consequently, the impact of edge effect the diversity of species in different layers. The present study shows that edge effects need to be examined when the size and potential buffer stripes of habitat protections are planned.

Impact of grazing management on phenological events of rangeland vegetation in West Africa

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Grazing systems are among the most important components of land use systems in West Africa. Climate change such as increasing climate variability, however, will be detrimental to livestock productivity. Therefore, the understanding of grazing systems' response to changing climate conditions is of crucial importance for the livelihood of rural people in the region.

Phenology is perhaps the simplest process in which to track changes in ecological systems. Numerous studies report shifts in plants' phenology as a consequence of climate change. Few phenological studies, however, come from sub-tropical regions. They show that there may be considerable variation between years and species in the timing of major phenological events. The length of the seasonal drought plays a crucial role in phenology. For deciduous trees and perennial grasses, a delay of a few weeks in the production of new leaves can severely affect livestock that depend on this forage resource. Thus remote sensing and modeling studies increasingly aim at separating phenological stages of different plant functional types (PFTs) in the subtropics to better capture variability and climate-induced changes. However, these approaches are limited by a lack of reliable, long-term observations, and an understanding how events are modulated by variable rainfall and grazing management.

We aim to study phenological events of PFTs in West Africa's Sudanian savannas. Along a regional grazing gradient, outdoor webcams were installed with Eddy covariance stations at three sites with similar mean annual precipitation; and nine simple 'plant-cams' were installed in a local grazing experiment which varies grazing pressure along a topographical gradient. Cameras provide subdaily data on excess green values for pixels representing PFTs such as deciduous trees or tuft grasses. Weekly sampling of plant biomass and recording of phonological events is matched to camera data. This talk will provide first results of the monitoring study.

Poster A49

Patterns of plant traits and ecosystem services in wooded habitats of agriculture-dominated landscapes

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Afforestation of agricultural landscapes and establishment of novel forest-like habitats are common processes in central and northern Europe. Such novel habitats may serve as alternative habitats for declining forest species threatened by fragmentation and degradation of historically continuous habitats. However, it is not clear whether these novel habitats provide the same ecosystem service providing traits as those of forest habitats. It is, therefore, necessary to understand the processes behind the dispersal and establishment of forest species, and how the functional diversity of novel habitats develops. Understanding these processes would enable us to evaluate the ecosystem services provided by these novel habitats. We described the trait distribution pattern of forest plants in habitats with contrasting history and structure: forests on ancient forest land, old planted parks, and corridor habitats. We then evaluated the importance of trait-environment filtering of species in fragmented landscape by estimating the factors affecting the species success of colonizing parks. We recorded the herb layer vascular plant species of 230 forests, 74 parks, and 151 corridors in southern Estonia. We additionally sampled 97 grasslands as reference habitats to obtain a species and trait pool of open habitats. We identified 107 species as forest specialists, 53 species as corridor specialists and 56 species as open habitat specialists using habitat scores from Non-metric Multidimensional Scaling ordination. The most contrasting patterns occurred in traits related to species establishment and resource acquisition, whereas traits connected to dispersal were less distinct. The development of forest vegetation into novel forest-like habitats was determined by a complex of factors instead of a single dominating one. Generalized linear mixed models predicting species arrival into old parks indicated that trait complex of species and habitat quality were both equally important, while landscape structure was of secondary importance. Forests and parks provided similar range of ecosystem services, whereas corridors provided only a subsample of services. Ecosystem services were mostly correlated with habitat quality and history, and were less affected by the dispersal capacity of occurring species. Novel forest-like habitats in agricultural landscapes can function as substitution of degraded ancient forest habitats, offering the same level of ecosystem services.

Iberian Atlantic forest restoration: an experiment inspired in vegetation succession

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An experience of forest restoration in the Atlantic area of the Basque Country is presented. It was intended to learn the criteria and the know-how for the revegetation of degraded areas with natural forests. The hypothesis we established for this survey were basically two:

1. Seral stages species have a higher survival rate than the mature stages long lived trees.
2. Growth during the first years is faster in the seral stages species than in mature stages trees.

The plantations were made in 1994 and the monitoring of the plots started with regular data collection. Here we present results with data obtained until 2008 (15 years). The plantations were made on three forests types previously defined by the geobotanical survey of the area:

- Subcantabric Mesophytic Oak Forest type (*Crataego laevigatae-Querctum roboris*).

- Eutrophic Montane Beech Forest type (*Carici sylvaticae-Fagetum sylvaticae*)

- Oligotrophic Montane Beech Forest type (*Saxifrago hirsutae-Fagetum sylvaticae*).

In each of the three plots six combinations of species and density were planted in the corresponding quadrats plus one of control. The different species combinations tried to reflect a dominance of pre-forest trees and shrubs, a dominance of mature stage trees and an intermediate stage. Data collection consisted basically on survival of individuals and growth (absolute and relative).

The most positive results for growth and survival yielded from Eutrophic Montane Beech Forest type. This can be attributed to better soil conditions and to the lower level of disturbing events. In general, shrub species presented a better survival than trees. In any case, secondary forest trees had a better growth than those of the mature forest in both beech forest plots, confirming the hypothesis that secondary forest trees should be recommended for degraded sites restoration experiences. However, in the oak forest plantation, Quercus robur in the fastest growing species in the oak forest plantation.

Environmental variables and aboveground plant traits predict plant biomass and root productivity in tropical savannas and seasonal forests

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Even though savannas and seasonal forests occur in a large portion of the globe, we do not have accurate estimates of plant biomass in these communities, especially concerning the belowground layer. An evaluation of the plant biomass, however, is essential to assess the role of vegetation in the carbon cycle. We aimed to predict plant biomass and root productivity in these vegetation types using environmental variables, such as soil, fire, and topographic features, and also plant species identity, species abundances, and functional diversity. We expected that higher nutrient soil content, lower fire frequency, and higher functional diversity would increase plant biomass and productivity. We sampled 100 plots in savanna and 20 plots in seasonal forest in Central Brazil. We estimated the aboveground biomass of tree species using allometric equations. We excavated and collected the root biomass to 100 cm depth. Moreover, we assessed fine root productivity in the top 40 cm of soil with an ingrowth core method. We selected the best models to predict above- and belowground biomass and fine root productivity using increasingly complex general linear models. Aboveground biomass was well predicted in savanna ($R^2 = 0.68$) and in seasonal forest ($R^2 = 0.64$), as well as belowground biomass in seasonal forest ($R^2 = 0.63$). Savanna belowground biomass ($R^2 = 0.30$) and fine root productivity ($R^2 = 0.36$), and fine root productivity of seasonal forest ($R^2 = 0.30$) had significant models, but with prediction power. High functional diversity was related to high aboveground biomass, but not to belowground biomass. Topographic features were not selected in any model. Although we found significant models in all cases, there was not a general relationship among plant biomass and increasing soil quality, functional diversity, and decreasing fire frequency, as we expected. The inclusion of soil and fire variables, as well as functional traits and species identities increased the prediction of plant biomass and root productivity. Belowground biomass in savannas and root productivity may be also influenced by biotic interactions, as competition among plants and herbivory.

Species distribution models on rare endemic plants towards targeted monitoring of the condition and dynamics of High Nature Value Farmlands in the Iberian Peninsula

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Rare species are the most in need for the outcomes from ecological modelling for conservation, management and monitoring purposes. They are also the most difficult to model due to restrictions imposed by available data. As so, there's a pressing need to a deeper knowledge regarding rare species distributions and dynamics and causes for such rarity, as they are most prone to extinction, under a world facing rapid changes (climate and land use related).

Habitat diversity and low intensity agricultural practices that characterize High Nature Value Farmlands (HNVf) have been related to high levels of plant diversity and the occurrence of several rare and endemic plant species. Further, the definition of farmlands with High Nature Value for conservation comprises areas in the countryside where farming supports rare species or a high proportion of known populations. The close relationship between such plant species and traditional agricultural landscapes, and the need for their conservation, has been acknowledged and targeted in the context of the Common Agricultural and Environmental policies.

Here, we advocate the application of species distribution models as more informative and statistically sound approaches to achieve deeper insights on the current distribution and underlying causes for rarity, and as tools to forecast future distributions for rare plants. Moreover, such approaches seem to be promising tools to refine mapping on the condition, distribution and dynamics of rural landscapes with high natural value, towards more effective and targeted monitoring programs.

Historical community composition and within and between population variation in Chara oosopore morphology

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Chara species are ecosystem key species in the Baltic Sea and in lakes. We have initiated work on using oospores from sediment to follow Chara community composition changes. The investigation area is mainly land-uplift coasts in central Sweden (Uppland). The data come from several pilot projects and exam works that together show the possibilities of using historical records of Chara communities. Oospores were collected from sediment cores and from living individuals and subjected to outline analysis using elliptic fourier transformation and multivariate statistics: discrimination and ordination. Samples were also subject to genetic analysis using AFLP for comparison.

Oospores from different species (Chara aspera, C. tomentosa and C. intermedia) can be separated using morhological and molecular genetic techniques. In Chara aspera oospores from different populations and to some extent oospores from different individuals can be distinguished. Supervised methods, classification of unknown oospores and unsupervised methods are compared on the same data. Sediment cores from adjacent ponds in a salinity gradient show that Chara species composition is very dynamic and that is varies in sequence between ponds.

The impact of accumulated nutrients on clonal propagation in species with different growth forms

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Number of vegetative offspring increases clone size and in case of persisting physiological connections increases the area of occupancy by a clone and provides better access to light in dense vegetation. Longer connections between individual ramets may further enhance benefits that a clone receives from dispersal. However, both longer connections and larger number of clonal offspring represent larger initial investments and sometimes also larger maintenance costs for a parent plant. Thus, in case of resource limitation a parent plant may need to choose between number and size of clonal offspring, which represents a classical life-history trade-off and strongly affects the fitness of clonal plants. However, there is surprisingly little information about how growth conditions of a parent ramet influence its ability to invest into clonal propagation.

We examined the impact of accumulated nutrients in parent ramet on the clonal propagation in 5 taxa of three species with different growth forms. Plants were initially grown in either nutrient poor (P) or nutrient rich (R) soil and then transplanted in all possible combinations of soil fertility (P->P; P->R; R->P; R->R). After three months transplants were excavated, washed from soil, and their biomass as well as size and number of clonal offspring measured.

The plant biomass increased with exposure to the nutrient rich soil as expected. In all taxa plant biomass was larger in P->R treatment than in R->P treatment, which indicates reduced importance of parent ramet investment and higher importance of growth conditions of offspring. However, in some taxa the number of offspring depended on parent growth conditions, not on growth conditions of an offspring. There was considerable difference in which treatment taxa had longest rhizome branches We detected the impact of storage products to the future growth in every taxa in our experiment. Plants, coming from rich soil can produce more biomass. However, the impact on the length of the rhizomes varies between growth forms.

We conclude that while the size of plants is proportional to nutrient availability, such relationship in traits of clonal propagation depends on the taxa and on the growth form. Thus, also the presence of a trade-off between number and size of clonal offspring is taxa and growth form dependent. We will discuss ecological and fitness implications of number-length trade-off in rhizome branches.

Scaling hierarchy of environmental variables controlling forest composition

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The search for causes dictating patterns in species distributions is often pursued through analysing the relationship between species distributions and environmental characteristics. Gradient analysis is an approach that aims to explain the differences at different various sampling locations using constrained ordination in a theoretical framework of gradient analysis.

In order to ascertain the effect of geographic space and scale of environmental variables on forest composition, we addressed the following three questions: (1) To what extent can species-compositional gradients be interpreted in environmental and geographic terms? (2) What is the influence of the local, regional and supra-regional scales of environmental variables on forest composition? (3) What is the influence of geographic distances and scale of environmental variables on individual forest strata?

We applied db-RDA to interpret species–environment gradients. Variation partitioning was used to explore the influence of scale on variation in species composition. The data set was separated into herbaceous, shrub and tree layers, and the influence of environmental variables on these forest strata interpreted. The scale at which the environmental variables function was established by means of semivariogram analysis. The environmental variables were classified into one of three scales based on a visual inspection of the resulting nuggets, sills, and range values. To investigate the influence of geographic space, we used a polynomial function of the geographic coordinates of the sampling sites to represent broad-scale spatial relationships to explain species variation.

The results of the db-RDA of the environmental variables on forest composition show that 51% of total variability is explained across all axes. In the full floristic data set, both the environmental and geographic variable matrices accounted for 55% of the observed variation. In addition, most (19%) of the spatial variation can be explained by geographically structured environmental variables. Only about 4% of the variation is attributed to purely geographic variables.

These results support our hypothesis that the geographic and environmental factors are interacting at a wide range of spatial and environmental scales. These factors also have different observed effects on the three forest strata.

To our knowledge, the current study is the first exploration into the influence of geographic coordinates and local, regional and supra-regional scales of environmental variables on forest composition in Africa.

Vegetation change in spruce swamp forests following drainage and rewetting

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The area of pristine spruce swamp forests in Finland has declined by 70% since the 1950s, mainly due to drainage for forestry and logging. As habitats of abundant dead-wood microhabitats and moist microclimate, pristine spruce swamp forests are valuable for regional species diversity. In rewetting, drainage ditches are blocked to restore the original hydrology and, ultimately, the ecosystem functions and biodiversity values of the pristine swamp forests. This study aims to examine the succession process after ditch blocking and to quantify restoration success.

We studied 18 restored spruce swamp forests, rewetted 1-14 years prior to the survey, 9 drained and 9 pristine swamp forests. In each site, we placed in total 72 sample plots, 30 cm in diameter, in a clustered design. In each plot, we estimated the cover of mosses and vascular plants and defined the microhabitat. Using CCA in the plot level, we studied the importance of microhabitats for plant community composition under each land use. Using RDA in the site level, we squeezed the plant community change into one linear variable by constraining the analysis by the pristine and drained land uses. The rewetted sites were added as supplementary cases in the ordination space: their first axis scores indicate their position in the pristine-drained gradient. To test and quantify the similarity/dissimilarity of the rewetted sites as a group to the drained and pristine sites, we performed ANOVA on the case scores. We tested the effects of time since rewetting and water level on the case scores using a linear model and likelihood ratio tests.

Microhabitats affected plant community composition differently under each land use. In pristine conditions, plant community composition was affected by dead-wood microhabitats. Stumps and logs provided habitats for specialized liverworts. In the drained sites, plant community variation was structured by ditch disturbance only. In the rewetted sites, ditch disturbance was still important, but elevated microhabitats had acquired shared importance for the community structure.

The rewetted sites as a group differed significantly from both the pristine and the drained sites, but 50% of the rewetted sites had already reached the pristine range of the gradient. Similarity to pristine sites did not increase linearly across time, but was regulated by water level. For successful restoration to occur, water table needed to be within 18 cm below moss surface.

Poster A50

Scale matters: Disentangling drivers of fine-scale and regional species richness pattern in temperate forest understorey

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Herb layer host most of the plant diversity in the temperate forests. While main determinants of the herb layer diversity are well known, relatively little is known about scale-dependency of the importance of these factors and its effect on community assembly.

In this study, we focus on the two most important environmental factors affecting herb layer diversity in temperate forests – soil pH and understorey light. We explored deciduous forest herb layer diversity in relation to the light conditions and soil pH at two spatial scales: landscape scale (100 m^2 plots within 535 km^2 area) and within-plot scale (five 1 m^2 subplots nested within each larger plot).

Heterogeneity of both light and soil properties observed among larger plots was roughly double compared to within-plot variation. Soil reaction was strongest predictor of diversity on landscape scale, but insignificant on fine scale. Contrary, light availability determined diversity stronger on fine scale, but still being influential on landscape scale. Therefore, the importance of soil pH and light is reversed between landscape and within-plot scale. This suggests that forest community assembly is driven by hierarchical processes when species growing in the plot are filtered from the regional species pool according soil pH, but exact species richness pattern within the plot is driven by light availability.

Poster E162

Comparing sand dune ecosystem in different phytogeographic regions based on plant functional types

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Studying plant functional traits instead of species composition is a promising way to simplify ecosystem complexity and to better understand the underlying ecological processes. The common characters of ecosystems drive plants to exhibit similar responses to the environmental conditions and these plants have similar effects on ecosystem processes. The adaptive mechanisms of plants can be discovered in their traits which can be used as an indicator for ecosystem function.

The main goal of this study is to examine to which degree sand dune ecosystems are independent from their climatic region in which they occur. While sand dune habitats in different climatic regions differ in species composition, they are characterized by common habitat factors such as lack of soil, organic matter and nutrients, drought, strong winds, sand accumulation and deflation and salt exposure. This results in having common plant traits in sandy habitats. In a first step we aim to identify the main functional traits of plants as well as functional groups in the sand dune vegetation. Three sand dune sites in the Hyrcanian, Irano-Turanian and Mediterranean phytogeographic regions were studied and about 300 relevés were collected. The matrix of 15 traits × 60 species were prepared for each region and multiplied by a matrix of species × plots. Multivariate and cluster analysis were applied to each matrix as well as to the resulting matrix of traits × plots.

Degree of salinity and water availability have an important effect in separation of vegetation communities. Four main functional groups were observed in all three regions: a) plants with long rhizome, clonality and stress tolerance strategy prevailing in the sand dunes; b) ephemerals and short life span plants; c) salt tolerant succulents d) ruderal plants mostly with annual life form. We consider functional groups as an effective tool for studying ecosystem functions and processes especially in regions with no or few species in common.

Species traits and environmental conditions as the basic determinants of population stability

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The determinants of population and community temporal variability remain elusive. Using a unique dataset, we analysed the temporal variability of plant species biomass (represented by coefficient of variation of species biomass) in unfertilized and experimentally fertilized mown grassland communities over 13 years. For the selected species we collected information on key functional traits expected to cover different axes of functional differentiation between vascular plants: plant height, leaf dry matter content (LDMC), specific leaf area (SLA), seed mass, leaf δ13C, root depth and life cycle. We then tested the predictive value of traits on the temporal variability of a species biomass with forward stepwise linear regression. Fertilisation and dominant removal (*Molinia caerulea*) were applied as treatments in factorial design. We tested their effect on species fluctuation over time using a three-way ANOVA. Further we evaluated the effect of climatic factors using Pearson's correlation test for each of the climatic factors and species biomass. While climatic conditions did not affect species fluctuations over time, we found significant effects of four plant traits (leaf dry matter content - LDMC, life cycle, root depth and leaf δ13C) and grassland management (fertilisation) on species stability. LDMC was, under different grassland managements, the main trait related to the species stability over time suggesting that species with more conservative nutrient acquisition strategies are more stable. Results also support the idea that fertilisation would make the communities less stable and more vulnerable against potential perturbations. These results demonstrate that trait-based and environment-based processes underlie temporal species variability. Understanding the determinants of stability in undisturbed conditions is important when predicting the responce of plant system to changing environmental conditions.

Biodiversity and ecosystem functioning – testing in different scales from fungal community to bryophytes and boreal tree species

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The loss of species diversity will alter ecosystems function, resiliency and their ability to provide ecosystem services. Primary productivity and ecosystem stability can be negatively affected by a loss of plant species and rate of decomposition and nutrient cycling may decrease with decreasing diversity. We tested (i) the effect of reduced fungal diversity on rate of decomposition in experimental microcosm study, (ii) the biomass production and overyielding of bryophyte species grown in mixtures in comparison to monocultures, and (iii) the effect of tree species mixtures on NPP of boreal forests over a simulation period of 100-years. In the microcosm study with diluted fungal communities measured response variable was cumulative CO_2 production over the experimental period of 3 months. In the bryophyte study we measured biomass production, and in the stand scale simulations of competing tree species over 100-year period we applied process based growth model (EFIMOD).

In these three studies of different scales we observed positive biodiversity effect on ecosystem functioning. The mixed forest stands of two or three competing tree species (*Picea abies*, *Pinus sylvestris* and *Betula pendula*) were more productive than monocultures; the highest overyielding was observed with mixture of two coniferous species. Biomass production of boreal bryophytes (*Pleurozium schreberi*, *Hylocomiun splendens* and *Dicranum polysetum*) showed overyielding when species were grown in mixtures in comparison to monocultures. In decomposing fungal communities positive biodiversity effect was observed with moderate species diversity, but not with most diverse communities due to the functional redundancy.

Poster D148

Does the landscape pattern affect alien plant invasion in Mediterranean coastal dunes? A patch based approach

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Although landscape fragmentation and species invasions are widely recognized threats to biodiversity, few studies have examined both threats together. Whether spatial pattern can affect alien plant species spread across the landscape still remains a controversial issue. We examined the effects of the spatial pattern of natural dune patches on alien plant invasion in the coastal landscape of central Italy. We created a detailed land cover map of seven dune sites on the Italian Tyrrhenian coast. The spatial pattern of natural dune cover types was characterized by computing a set of patch based metrics that describe their: structure (size and shape), edges (shared boundaries with others cover types) and neighborhoods (Euclidean nearest neighbor and minimum Euclidean distance with other cover types). To quantify patch alien invasion, we used a geo-database of 16 m² vegetation plots that includes the list of all vascular plant species, both natives and aliens, available for the study sites and distributed on coastal dune cover types. First, we fit a generalized linear model (GLM) with binomial errors to asses which spatial parameters mainly influence patch invasion by alien species. Second, we extracted invaded patches and by GLMs we investigated how their spatial pattern affects average alien species richness and cover. We also accounted for spatial autocorrelation and variation across study sites. We found that alien occurrence was strongly dependent on spatial factors and on the different study site of the considered coastal dune landscape. We reason that the occurrence of alien species is mainly dependent on the land use history of the sites and on whether and how they were initially introduced. Besides, when considering alien plant richness and cover within invaded patches we observed a negative correlation with patch size, shared borders with artificial areas and, distance from other dune cover types. It seems that locally the number and cover of alien plant species increase with the intensity of ongoing fragmentation processes and the contact with artificial areas. Moreover, the diffusion of alien species seems to be facilitated by the patch proximity with other natural dune cover types, which may act as corridors in less urbanized sites. The proposed patch based approach seems very promising and contributes to improve the development of more accurate models of alien species invasion and spread. The results highlight that the ecologist must consider the importance of landscape pattern and fragmentation processes in managing alien species invasions.

Poster D123

Investigating and modeling the effect of competition on annual tree radial growth for Estonian Silver birch

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The longevity of trees and forest stands forces the researcher to use theoretical and experimentally derived relationships and integrate these into different growth models. Forest stands cannot be investigated under controlled and managed environmental conditions and the simulation of stand growth is becoming increasingly crucial, in light of the uncertainty induced by climate change and the increasing variable pressures on forest ecosystems. Thus only models that take these changes into account can be expected to predict the stands' behavior realistically. In this study annual radial growth, expressed by ring width sequences, was examined in Estonian silver birch (*Betula pendula*) forest in relation to stand structure, individual tree competition and climate. In order to investigate the effect of different competition levels on trees diameter growth, in first step chronology indices that were calculated based on tree cores data were used to evaluate the influence of climatic factors on annual diameter increment. As there was statistically significant effect of climatic variables on radial growth more precise yearly diameter increment were obtained regarding mentioned indices and seasonal radial growth curves. Moreover some spatially and non-spatially explicit competition indices were computed in different conditions of influence zones and species-specific light transmission factors (LTF). Finally using annual diameter growth, competition indices, site quality, relative density and other effective variables some growth models were developed and compared to find the most accurate radial growth predictor among studied indices and variables. The results of different growth model analyses indicated that the models which are built based on spatially-explicit competition indices A: in the influence zone proportional to tree dimensions, B: species-specific considering light transmission factors and C: standardized chronology indices significantly are not better growth predictors for Estonian birch forests.

Poster E178

Assessment of tree mortality in managed and unmanaged forest stands in Estonia

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Assessment of tree mortality provides deeper understanding of forest structure and functioning. This enables evaluation of stand sustainability and provides information on stand productivity, diversity and health condition. Tree mortality can be assessed by spatiotemporal patterns as well as by studying the processes and causes of mortality. Tree mortality is caused by specific disturbance agents or by the complex effect of various disturbances.

The purpose of this study is to examine tree mortality of Estonian forests, determine the causes of tree death, and estimate whether different management regimes affect tree mortality and its causes. This study is based on 360 sample plots measured in the early summer of 2003-2005 and 2008–2010. The sample plots were divided into managed (146) and unmanaged (214) sample plots based on forest management regime. In total, 53,990 trees were measured, of which 20,020 were on managed and 33,970 on unmanaged sample plots.

The tree mortality for 5-year period was 3.4% on managed sample plots and 8.0% on unmanaged sample plots. Main cause of tree mortality in managed stands was insect damage, which attributes to 29.8% of other causes of death, whereas in unmanaged stands the main cause was competition, which attributes to 45.4% of tree mortality. Analysis of the tree mortality indicated that increase in relative tree diameter in both stand types contributes to the increase in mortality due to insect or fungal damage or diseases. Contrary results were received with respect to competition – the smaller the tree relative diameter, the more probable it is that a tree will die because of competition with neighbouring trees. Analysis of game damage, wind, and other causes of tree mortality showed that these were not dependent from relative diameter of trees. Analysis of overall probability of tree mortality revealed that relatively smaller trees have higher probability of mortality than larger trees. Probability of survival of smaller trees is higher in managed stands compared with unmanaged stands.

Differential radial growth patterns between beech (*Fagus sylvatica*) and oak (Quercus robur) on periodically waterlogged soils

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Climate scenarios for northern Central Europe project rising temperatures and increasing frequency and intensity of droughts but also a shift in precipitation pattern with more humid winters. This in turn may result in soil waterlogging during the following spring, leading to increasing stress for trees growing on poorly drained sites. The influence of waterlogging on growth of common beech and pedunculate oak has been studied intensively on seedlings under experimental conditions. However, the question remains whether results of these studies can be transferred to mature trees growing under natural conditions.

To test this, we investigated general growth patterns and climate–growth relationships in four mature stands of beech and oak growing on poorly drained, hydromorphic soils (Stagnosols) in northeast Germany using dendrochronological methods. Our results confirmed the expected tolerance of oak to strong waterlevel fluctuations. Neither extremely wet conditions during spring nor summer droughts significantly affected its radial growth. Oak growth responded positively to warmer temperatures during previous year October and March of the current year of ring formation. Contrary to our expectations, also beech showed relatively low sensitivity to periods of high soil water saturation. Instead, summer drought turned out to be the main climatic factor influencing ring width of beech even under the specific periodically wet soil conditions of our study. This became evident from general climate–growth correlations over the last century as well as from discontinuous (pointer year) analysis with summer drought being significantly correlated to the occurrence of growth depressions.

As ring width of the two species is affected by differing climate parameters, species-specific chronologies show no coherence in high-frequency variations even for trees growing in close proximity. We assume differences in rooting depth as the main reason for the differing growth patterns and climate correlations of the two species under study. Our results indicate that under the projected future climate scenarios, beech may suffer from increasing drought stress even on hydromorphic soils. Oak might be able to maintain a sufficient hydraulic status during summer droughts by reaching water in deeper soil strata with its root system. Wet phases with waterlogged soil conditions during spring or summer appear to have only a little direct influence on radial growth of both species.

The role of resistance and resilience in ecological restoration

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Background: The search for appropriate management strategies to control invasive plants is important theme in ecological restoration, but often the recovery of the target community species complement does not do what ii is meant to! Improving restoration success inevitably requires knowledge of the relative resistance/resilience of both the invaded and target communities in response to management.

Objectives: We investigated the resistance/resilience of *Pteridium aquilinum*-control treatments during restoration. Methods: We evaluated seven field-experiments across Great Britain designed to test *Pteridium*-control treatments, including "one-off" (applied only at the start) and "repeated" treatments (applied regularly), against an experimental-control. The sites also had context dependent restoration targets, either a *Calluna*-heathland or acid-grassland. Species cover was monitored annually for 10 years. We compared change in vegetation community composition using Principal Response Curves.

Results: Restoration treatments induced significant change in species composition compared to controls in both vegetation types. On *Calluna*-targets, "repeated" treatments overcame the resistance of the invaded community producing a gradual divergence in species composition and species diversity. In contrast, the "one-off" treatments were ineffective. At the acid-grassland targets, all treatments overcame the resistance of the *Pteridium*--dominated state producing changes in species composition in comparison to experimental-controls.

Conclusions: Where *Calluna*-heathland was the target, "repeated" treatments were effective in overcoming the resistance of the invaded community and moving species towards the target, effectively creating an alternative state. Where acid-grassland was the target both "one-off" and "repeated" treatments overcame the invaded community resistance ("one-off" also overcame resilience) producing changes in species composition in the correct direction. On the acid-grasslands, "one-off" treatments produced alternative stable states within 10 years.

Local plant community assembly from the regional species pool

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A local plant community only consists of a small fraction of plant species found in the surrounding region. Among factors that influence which species are found at the local scale are seed limitation and establishment limitation. Seed limitation is either caused by source limitation; the lack of propagule production in the region, or dispersal limitation; the propagules produced fail to reach the local site. Species establishment at a site can then be limited either by unsuitable abiotic conditions i.e. environmental limitation or competition with other species i.e. niche limitation. The relative importance of these different factors is highly debated.

The aim of this study was to explore the importance of these different factors in local community assembly, using both models and experiments.

The study took place in a cultivated landscape in southeastern Sweden. Plant species assembly was explored in 12 ex-arable field sites (local species pool) and in a 100 m radius around each site (regional species pool). Models were used to examine if species abundance and functional traits (height, seed mass, clonal abilities, SLA and dispersal method) controlled the filtering of species from the regional pool into local communities. In addition, at each site seed augmentation and transplanting experiments were conducted to estimate the level of site seed and establishment limitation. Of the sown/transplanted species at each site, a third were from the local species pool, a third from the regional species pool and a third were grassland species neither found in the regional nor local species pool. Species were both sown in disturbed and undisturbed plots. The establishment and survival of sown and transplanted species were followed for three and two years, respectively.

Species abundance in the regional pool was positively correlated with species occurrence at the local scale. Results from the random models indicated that species assembly at the sites was influenced by both dispersal limitations and species competition causing biological trait convergence. Seed augmentation and transplantation increased species establishment, indicating seed limitation and establishment was higher in disturbed plots, implying niche limitation. Survival over the study period was however low, pointing towards some additional limitation on establishment. The results also revealed that local species did establish better than non-local species.

Which species from the regional species pool establish at the local scale was highly influenced both by dispersal and niche limitation. Thus both local and regional processes effected local community assembly.

Assessing environmental suitability for species based on Tukey's depth

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There is a proliferation of methods based on Hutchinson's niche concept to estimate the suitability of ecological conditions to species. The first proposals were simple geometric approximations to the shape of the niche. BIOCLIM and HABITAT are examples of geometric procedures, which attempt to characterize the niche by a number of linear inequalities on a set of appropriate environmental variables. Later, other methods were developed relying on sophisticated statistical approaches, such as generalized linear and additive models, and maximum entropy.

Yet, BIOCLIM and part of the HABITAT procedure enclose some attractive features: (i) only occurrences are required; (ii) the geometric manipulations do not depend on the scale of the ecological variables; (iii) they describe the suitability conditions in very simple and interpretable terms. BIOCLIM identifies the range of suitable values for each environmental variable independently of the other variables. This defines a hyperrectangle bounded by minimum and maximum values of each environmental variable for the species known occurrences. The use of the convex-hull to outline the species niche (hereafter referred as CH-approach) reduces the bounding box produced by BIOCLIM to the convex-hull of the points corresponding to species' occurrences, thus accounting for dependencies of the ecological variables on their effect over species. These two methods exhibit a binary nature: a location is suitable (or unsuitable) if the point defined by the values of the corresponding ecological variables lies inside (or outside) the region that the method identify as suitable (bounding box for BIOCLIM, the convex-hull of occurrences for the CH-approach).

To distinguish suitability levels within the niche, some methods use nested hyperrectangles obtained from a pre-defined set of univariate percentiles applied simultaneously to all environmental variables. In this way they incorporate Hutchison's perception of a optimal part of the niche versus a suboptimal one near the boundaries. We propose to extend this strategy to the CH-approach, using Tukey's depth, a mathematical notion of interiority with respect to a set of points, to consistently establish a range of suitability levels within the convex-hull. Tukey's depth is a robust multivariate counterpart of the univariate percentiles. This discriminated CH-approach permits to surpass one of the major drawbacks of BIOCLIM methodology: the assumption of independence of the ecological variables on their effect over species. We illustrate this methodology producing environmental suitability maps for the main Quercus species of the Iberian Peninsula.

Arbuscular micorhhizal fungal communities in Eastern Texas, USA Forests

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We report a series of studies where we investigated communities of arbuscular mycorrhizal fungi (AMF) from eastern Texas, USA, forests. We sampled roots from three widely-occurring native host plants: *Callicarpa americana, Chasmanthium sessiliflorum,* and *Toxicodendron radicans.* We used denaturing gradient gel electrophoresis (DGGE) to separate AMF PCR products of 18S rDNA amplified from DNA extracted from the root samples. We also used 454 pyrosequencing for a portion of the samples. Results indicated that many AMF taxa showed preference for certain host plants. Differences in AMF communities were also related to position on a hill slope and to the ecosystem type (based on vegetation, soil type, topographic position, and hydrology) of the site from which the sample was collected. AMF communities also shifted seasonally with soil moisture levels being more influential than temperature or month of the year.

Mediterranean steppe plant communities are more strongly impacted by water stress removal than by former disturbances linked to cultivation

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Since several decades, the Plain of La Crau in South-Eastern France is undergone to many land-use changes which impact the steppe plant community. This context is an opportunity to measure in situ the respective impacts of disturbance regimes (as former cultivation phases) and of a removal of stress (as water infiltration) on the structure of a steppe plant community and on its successional dynamic through the proliferation of *Rubus ulmifolius* Schott, the elm-leaves bramble. We compared the species and functional richness, the diversity and similarities between the original steppe vegetation, the steppe impacted by a former phase of cultivation and/or current water infiltration (in presence or not of brambles). Our results showed that the steppe community had a significantly higher species-richness than the communities subjected to disturbance or stress removal and showed a low similarity with them. Although, cultivation induced a dominance of ruderal type species, the removal of water stress caused a stronger impact, favouring competitor species, in particular *Brachypodium phoenicoïdes.* The dominance of this species led to a significant decline in the species richness and the evenness. Nearby the bramble bushes, when the grazing was still practised, no effect was observed on plant species-richness. However, although this effect was lower than that of water infiltration, the plant composition was significantly different. In this study, we confirmed the very low resilience of the steppe after a former phase, but mostly we evidenced for the first time that the stress removal had a stronger impact on the decrease of plant species-richness and diversity. Indeed, the water availability favoured the development of competitor species at the expense of steppe vegetation, composed by many stress-tolerant species. If the presence of bramble does not appear to have effects at the moment on the plant community, at long term, its dynamic could lead to the loss of the herbaceous vegetation and its cover, if traditional sheep grazing would be abandoned. In order to maintain or to realize an ecological restoration of this steppe, the controls of water infiltration and of the dynamic of *R. ulmifolius* seem to be necessary.

Boreal forests and permafrost types: Reconsideration of doughnut-ring

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Forest ecosystems, where conifers dominate in circumpolar region are called as "taiga" or "Boreal forests". The circumpolar region is also specific region of permafrost dominant biomes. Permafrost is classified into three types according to distribution patterns (continuous, discontinuous, and sporadic or isolated permafrost). Boreal forest ecosystems are thought to be uniform as one doughnut-ring zonal biome. More than 70 soil profile survey and soil C and N storage of forest biomes in circumpolar region reflected regional characteristics. Those data shows that doughnut-ring is not uniform. I propose a reconsidered scheme for circumpolar biome classification related to permafrost types. Biomes in circumpolar region should be divided into large two parts by dominant tree lifeform; evergreen and deciduous. Then we should take permafrost types into account to characterize, namely, i) deciduous conifer *Larix* dominant on continuous permafrost (in central and eastern Siberia), ii) evergreen *Picea* dominant on discontinuous permafrost (Interior Alaska), iii) evergreen *Pinus* and *Picea* with deciduous broad-leaved *Populus* mosaic on sporadic permafrost, and iv) non-permafrost region with evergreen dominant (from Scandinavia to west Siberia and eastern north America). We can estimate and predict more precisely about the effect of global warming on biome behavior and carbon storage when we classify circumpolar doughnut-ring forest biomes into such reconsidered scheme.

Contrasted responses of taxonomic, phylogenetic and functional diversity to grassland management

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Diversity of grassland plant communities is impacted by management regime. Many experimental studies revealed that an increase of disturbance intensity leads to a reduction of taxonomic diversity, associated with differences in functional traits. However, the combined effects of these processes on taxonomic and functional diversity are difficult to predict due to the multifactorial determinism of grassland dynamics and the mixing of different agricultural practices applied to management units, In addition, phylogenetic diversity recently showed efficiency to reveal complementary processes involved in communities responses to productivity gradient, linked to historical filtering induced by long-term management.

Our purpose was to compare patterns of taxonomic, phylogenetic and functional diversity in meadows and pastures, and to relate them to management practices.

We selected 48 grassland management units (parcels), distributed across the French Jura Mountains. Inside each parcel, vascular plant species and their cover-abundance have been recorded in four plots of 10 m². Questionnaire to farmers provided information on agricultural practices applied to parcels. From the management data we defined five contrasted types of parcels and selected four main potential explanatory variables: organic and mineral nitrogen input, mowing and grazing intensity (amount of dry biomass removed). The sum of the two first variables represents a fertilization gradient and the sum of the two last a disturbance gradient.

We computed taxonomic, phylogenetic and functional diversity indices, considering richness and evenness components. The responses of diversity indices to management practices and parcel types were contrasted using univariate and multivariate regression analyses.

Results indicate that indices taking into account the relative abundance of species were more sensitive to the management regime than those based on presence–absence. When comparing the five parcel types, lower taxonomic and phylogenetic diversities were recorded for mowed parcels, while responses of functional indices varied with the considered trait.

Organic or mineral nitrogen input and mowing intensity had negative effects on taxonomic and phylogenetic diversities while grazing intensity enhanced these values. Grazing pressure favoured functional diversity regarding clonal growth organs and organic fertilization reduced functional indices for leaf dry matter content. In addition, we observed that disturbance gradients (mowing and/or grazing) seemed to better explain taxonomic indices by whereas fertilization intensity impacted preferentially phylogenetic diversity.

The present comparative study highlights the contrasted responses of plant diversity indices to agricultural management. Potential implications to the search of biotic indicators of current or recent management in permanent grasslands are discussed.

Grazing dry grasslands: emerging patterns on different spatial scales

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Dry grassland communities in the cultural landscape of Central Europe have been traditionally subjected to grazing. In the 20th century pastures have been widely abandoned and colonised with woody vegetation, shrubs and mesophilous grasses. This led to a decrease in rare species occurrence on former pastures and also a decrease in habitat heterogeneity on landscape scale. We observe the effects of re-established rotational grazing management on selected former pastures with valuable, species rich dry grassland communities. The aim of grazing management is to conserve high levels of species richness and promote often threatened species of open habitats.

Since 2005 we collected data on vegetation cover and species composition and richness on grazed and control permanent plots. After seven years, collected data show significant difference between the development of grazed and control plots in terms of both species number and species composition. On two sites with high initial species number per 1m² we show a decrease in species richness on ungrazed plots. On one site with lower initial species richness we show a significant increase in species number per 1 m² on grazed plots. On each site we can see then either an effect of grazing absence or an effect of grazing presence, depending on initial species richness. In addition we show a decrease of beta diversity between plots on each site and between sites, in combination with an increase of alpha diversity on individual 1m² plots.

Grazing, such as is in practice on our sites, thus promotes species coexistence at the individual level, increasing heterogeneity on a small scale, and supports species dispersion between sites, increasing homogeneity on a large scale.

Poster A51

Estimation of species number in different habitat types and ecotones at several spatial scales

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A typical central European landscape consists of a mosaic of different (semi)natural and anthropogenic habitats. It is well known that these vary in total species richness and in the richness of particular species groups (e.g. archaeophytes or neophytes), but most richness estimations were based on small sampling units (e.g. vegetation plots) and it is poorly known whether the same diversity patterns exist at larger scale. Moreover, some existing estimates may be biased due to preferentially sampled data. Some studies suggest that also ecotones may by characterized by high species richness due to mixing species from adjacent habitat types or an occurrence of species specialized to ecotonal habitats.

This study focuses on three main questions: a) Which habitat types or ecotone types are the most species rich in terms of total species number and number of selected species groups (i.e. archaeophytes, neophytes and endangered species)? b) Are habitat types that are species-rich at a local scale (16 m²) also rich at larger scales (from 2,000 to 30,000 m²)? c) Do ecotones represent diversity hotspots in the studied landscape?

The study area is situated in the south-east of the Czech Republic. It includes a limestone range (Pavlov Hills) as well as a gently undulating landscape with a mosaic of (semi)natural and anthropogenic habitats. Plant species were recorded according to stratified sampling scheme at four different scales (16 m², 128 m², 2000 m² and 30000 m²; recorded in vegetation plots, patches of different habitats or linear features of ecotones). Diversities were compared using sample-based rarefaction curves and species-area curves.

At local scale (16 m²), high number of all species and high proportion of endangered species were observed in dry grasslands. Ecotones between non-forest and non-forest habitats and arable fields/vineards had high proportion of archaeophytes. Diversity patterns at different scales were not identical, although some trends were observed across all scales. Finally, we revealed that some but not all types of ecotones may serve as diversity hotspots, especially those between forest and non-forest vegetation. Here species richness was comparable to that found in dry grasslands, whereas other ecotone types (ecotones between non-forest and non-forest habitats or ecotones between non-forest habitats and roads) were intermediately species rich.

Communities: are they groups of hidden interactions?

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We analysed how plant-plant interactions drive community composition and diversity in a species-rich subalpine shrub-grass community from the eastern Tibet plateau (China). Specifically we tested two main hypotheses. First, we hypothesized that in this intermediately stressful environmental conditions direct facilitation of forbs by shrubs are counterbalanced by indirect competive interactions due to increase grass-forbs competition below the shrubs. Second, we hypothesized that both direct and indirect interactions contribute to community composition and diversity.

We manipulated both the shrubs and grasses presence using a removal procedure and calculated direct and indirect effects of shrubs and grasses on forbs at the species and community level. We also conducted a Correspondence Analysis on community composition and a Principal Component Analysis on direct and indirect responses of forbs to shrubs and grasses. We correlated the results of the PCA to that of the CA to assess the contribution of plant-plant interactions to community composition. At the community level there were no significant interactions between the forbs and either the shrubs or the grasses. In contrast, at the species level we found strong and significant direct and indirect interactions between particular forb species and either the shrubs, the grasses or both. The PCA analysis allowed us to build forb groups of interactive responses, defined by both their direct and indirect responses to the shrubs and the grasses. Finally, we showed that PCA forb groups scores significantly correlate with CA releves scores, showing that direct and indirect forbs responses to both shrubs and grasses contribute to community composition. Our work suggests that communities are built of interaction groups that contribute to community composition although no interactions may be quantified at the community level.

Poster D137

Interactive effects of climate and disturbance on seedling performance in alpine grassland ecosystems of Western Norway

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Studies of climate change effects on plant demography usually focus on temperature, yet, temperature is likely to interact with other climate variables (e.g. precipitation), as well as with the small-scale disturbances that are so critical for seedling establishment in many vegetation types. We recorded seedling recruitment in intact vegetation and small gaps in grasslands across a climatic grid in subalpine and alpine areas of Southwestern Norway. We monitored survival of cohorts of forb seedlings over two years. In undisturbed vegetation, seedling recruitment and establishment of all forbs combined did not change along either the temperature or precipitation gradient. Disturbance increased seedling recruitment and establishment overall, and had effects in warmer sites. Survival was not affected by gaps, and trends in survival along the temperature or precipitation gradients were weak. Species were not all equally affected by disturbance and climate; the temperature-dependent effect of disturbance on recruitment depended on species traits (seed mass and SLA). Smaller seeds were more likely to germinate in gaps and in colder sites, where larger seeds usually prevails. Disturbance also facilitated the germination of species with slow SLA at the colder sites, suggesting that stress-tolerance might be important. Thus climate change is likely to influence community assembly through temperature-regulated processes acting on dispersal, germination and plant growth.

Poster D124

Facilitation effect of *Racomitrium lanuginosum* for pioneer species on the volcanic barren

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In volcanic barren on alpine regions, facilitation by cover plants is an important function to develop vegetation. Some studies in terms of facilitation on alpine regions have been carried out focusing on vascular plants. The objective of this study is to investigate whether patches of moss cushion, *Racomitrium lanuginosum*, have an effect of facilitation to establish pioneer vascular plant seedlings in the early stage of primary succession and also have a function of environmental formation on a volcanic barren of Mt. Fuji, central Japan. Distribution of *R. lanuginosum* patches and pioneer plant seedlings, the seedling size and environmental factors around the patches were investigated. The collected data were compared the inside and the outside of *R. lanuginosum* patches. In the patches, seedlings were found more frequent and the number of species was much more than the outside. Although some species occurred in both, more frequent inside of the patches. The sizes of *Betula ermanii* and *Salix reinii* in the inside were bigger than the outside. Fluctuation range of ground temperature beneath the patches showed narrower than it under bare grounds, especially in summer season. *R. lanuginosum* patches on the volcanic barren in Mt. Fuji have important role to constrain severe condition, e.g. increased temperature in ground surface, there. Thus relationship between existence of *R. lanuginosum* patches and seedling distribution was recognised roughly, and *R. lanuginosum* patches provide suitable environmental factors for seedling establishment on such harsh environment with extreme high temperature.

An evaluation of flexible shortest path adjustment in the ordination of vegetation data with high beta diversity

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In vegetation data of high beta diversity, many pairs of sampling units (SUs) have no species in common. Dissimilarity measures that are effective for analysis of community data (e.g., Bray-Curtis index), take their maximum value for all such disjunct pairs. Although disjunct SUs have different degrees of separation along underlying ecological gradients, their dissimilarities contain no information about these differences. Ordination methods that assume a linear relationship between dissimilarity and inter-point distance, such as principal coordinates analysis (PCoA) and metric multidimensional scaling (MMDS), attempt to assign equal distances to all disjunct pairs, resulting in the well-known horseshoe effect. Flexible shortest path adjustment (FSPA), which re-estimates dissimilarities between disjunct SUs as the sum of dissimilarities along the shortest pathway through SUs that do share species, has been suggested as a solution to this problem. Preliminary evaluations of FSPA suggested the adjustment is sensitive to sampling. Furthermore, nonmetric multidimensional scaling (NMDS) has been shown to successfully ordinate community data of high beta diversity without any adjustment of dissimilarities. We performed a multi-factorial experiment to compare the effectiveness of PCoA, MMDS, and NMDS, each applied with and without FSPA, in recovering the structure of simulated vegetation data. Ordination performance (as measured by the Procrustes badness-of-fit between the ordination and the configuration of SUs in the simulated ecological gradient space) was significantly improved by FSPA for both linear methods (PCoA and MMDS), provided that sampling was dense and relatively even. With sparse or uneven sampling, FSPA generally overestimated the degree of difference between disjunct SUs, resulting in deterioration of ordination performance. This occurs because the lack of SUs in some regions of gradient space necessitates the use of sequences of SUs to re-estimate dissimilarities between disjunct SUs that lie along convoluted pathways. Improvements in performance of linear ordination methods by FSPA were greatest at higher beta diversities, especially when the beta diversities of simulated gradients were unequal. NMDS performed well without FSPA, and further improvements in fit due to FSPA were modest. Significantly, NMDS without FSPA often gave results that were better, or no worse, than the linear methods with FSPA. The robust assumption of a monotonic fit between ordination distances and dissimilarities allows NMDS to utilize information in the smaller dissimilarities to resolve the ambiguity of dissimilarities among disjunct SUs. Consequently, FSPA is not required for effective ordination of high beta diversity vegetation data.

Ecosystem multifunctionality is determined by key plant traits: evidence from a salty grassland

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The assignment of different traits to ecosystem properties and to the species which express them most strongly contributes to the understanding of of loss of biodiversity, particularly against the background of global change and human induced habitat destruction. In our study, we explored the responses of morphological, chemical and allocation plant traits of salt marsh species on the community level to the environment and examined their effects on properties of the carbon cycle, i.e. aboveground biomass (AGB), ANPP (Above Net Primary Productivity), decomposition, and species richness as an indicator of biodiversity as ecosystem service. We used path analysis to evaluate relationships between environmental parameters, functional traits and ecosystem properties and estimated total model fitness by structural equation modelling (SEM). Keystone response and effect traits were belowground dry mass (BDM) responding to groundwater level and salinity, and leaf C:N ratio and specific leaf area (SLA) responding to inundation frequency. Inundation and salinity led to higher allocation in belowground biomass and adaptation to salt stress in leaves (low C:N ratio), which resulted in more rapid turn-over of resources by decomposition and facilitated species richness. Conversely, release from these strong abiotic controls resulted in accumulation of standing biomass, plant litter, and low species richness which was controlled by high leaf C:N ratios and aboveground allocation. Our study underlines the importance of multiple traits generating different response-effect relationships for maintaining carbon cycle properties and biodiversity.

Poster B73

Comparative characteristics of spatial heterogeneity in three types of virgin spruce forests

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Averaging of parameters of heterogenic plant communities and neglect to range of vegetation contour are significantly influence on conclusion of investigation of diversity, structure, dynamics and other processes in vegetation.

This report is devoted to relation between diversity and sharpness of groundcover patches in contrast forest types.

We described in details three plots (each 0.04 ha) in streamside (54 patches), nemoral (27 patches) and boreal (53 patches) spruce forests in Central Forest Biosphere Reserve (Tver' region, Russia). Next parameters of heterogeneity were analyzed: number of different scale patches and patches with different genesis per 0.04 ha; dissimilarity between elements of heterogeneity by groundcover layers composition (Jaccard index) and groundcover layers structure (Euclidean distance), species number per patch and average Shannon index for patch types.

Streamside forest is a spruce dominated forest with broad-leaved species in tree layer. The community is formed on flat but not even bottom of stream valley. Large elements of heterogeneity of groundcover are caused by heterogeneity of the site condition and tree layer structure (only tree layer heterogeneity is a cause of the same in two other forest types). Middle and small elements of heterogeneity are caused by influence of tree individuals, herbs clone growth, windfall, small animals (e.g. ants). Main dominants in herb layer are *Athyrium filix-femina*, *Dryopteris expansa*; species of *Mniaceae* and *Brachytheciaceae* dominate in moss cover in the most of patches. 7 large patches which belong to 5 patch types are described in the streamside forest plot. Shannon index and herb species richness has a maximal value in this forest type.

Nemoral forest is a spruce dominated watershed forest with co-dominance of maple. Main dominants in herb layer are *Galeobdolon luteum*, *Oxalis acetosella*, *Dryopteris expansa*. 6 large patches which belong to 4 patch types are described in the nemoral forest plot and 1 patch of other patch type is described out of the border of the plot.

Boreal forest is a spruce dominated watershed forest. Main dominants in herb layer are *Vaccinium myrtillus*, also *Oxalis acetosella*; feather mosses and *Sphagnum girgensohnii* dominate in different patches in moss cover. Groundcover is presented by 4 large patches of 4 patches types. Streamside forest consists of numerous patches highly contrasting by structure but moderately contrasting by species composition. Nemoral spruce forest also consists of numerous patches contrasting such by structure as by composition. Boreal spruce forest has less pronounced heterogeneity.

Poster D125

Plant trait assembly affects superiority of grazer's foraging strategies in species-rich grasslands

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Background: Current plant – herbivore interaction models and experiments with mammalian herbivores grazing plant monocultures show the superiority of a maximizing forage quality strategy (MFQ) over a maximizing intake strategy (MI). However, there is a lack of evidence whether grazers comply with the model predictions under field conditions where the selection of a high quality diet could be impeded by its low abundance or complex spatial distribution.

Objectives: The superiority of foraging strategies can be tested with selective grazers such as sheep (Ovis aries) grazing species-rich grasslands with different plant trait assembly, where a grazer's diet selection can be compared at several spatial scales simultaneously.

Methods: We assessed sheep diet selection using plant functional traits in productive mesic vs. low-productivity dry species-rich grasslands dominated by resource-exploitative vs. resource-conservative species respectively. Each grassland type was studied in two sites for two years. We investigated the first grazing cycle in a set of 288 plots with a diameter of 30 cm, i.e. the size of sheep feeding station. Statistical analyses were done with linear mixed effects models where site code in a given year of observation was considered as random effect.

Results: In mesic grasslands, plot defoliation was positively correlated with the proportion of legumes, community aggregated forage indicator value as well as with leaf traits referring to high forage quality, i.e. low leaf dry matter content (LDMC) and high specific leaf area (SLA). In dry grasslands, high community aggregated canopy height, an estimate of forage quantity, was the best predictor of plot defoliation. Similar differences in sheep selectivity on forage quality vs. quantity were detected within plots (i.e. within feeding stations). At each plot we calculated Jacobs' selectivity for the sum of species possessing higher trait values than the proportion-weighted trait mean of the plot. Sheep selected taller plants than the proportion-weighted mean of canopy height at each plot in dry grasslands whereas plants with higher than average forage indicator value were selected in mesic grasslands. However, at this scale sheep avoided legumes and plants with higher SLA, preferred plants with higher LDMC while grazing plants with higher forage indicator values in mesic grasslands.

Conclusion: Our findings indicate that MFQ appears superior over MI only in habitats with a predominance of resource-exploitative species. Furthermore, plant functional traits (LDMC, SLA, nitrogen fixer) seem to be helpful correlates of forage quality only.

Biotic interactions are driven by multiple environmental gradients

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Impacts of biotic interactions on plant communities vary with environmental conditions. The stress-gradient hypothesis (SGH) is the prevailing theoretical concept describing this variation in the outcomes of interactions. The SGH posits that net positive interactions are more common in abiotically extreme environments, while net negative interactions dominate under milder conditions. In general, studies of biotic interactions have considered only single environmental gradients, despite multiple drivers impacting vegetation. Thus, the explicit simultaneous consideration of multiple gradients could improve predictions of the outcomes of biotic interactions, and may explain some of the discrepancies between observed and predicted patterns.

To test this hypothesis we examined the impact of *Empetrum nigrum* ssp. *hermaphroditum* on the reproductive effort of 17 species simultaneously along soil moisture and geomorphological disturbance gradients. *Empetrum nigrum* is the dominant species of arctic-alpine vegetation with demonstrated competitive and facilitative characteristics. Data was collected from mountain tundra in northernmost Finland, with this dataset comprising 960 1 m^2 cells. Data were analysed using generalized linear models, with generalized estimation equation models used additionally to account for the spatial structure in the data.

The inclusion of multiple gradients improved models of reproductive effort for the majority of species. Reproductive effort was related to one or both abiotic variables for all species. Fourteen species were additionally influenced by *E. nigrum*, with the impact of *E. nigrum* varying with abiotic conditions in all but one of those species. Thus, biotic interactions play an important role in arctic-alpine vegetation and their outcomes are dependent on environmental severity. The SGH was not consistently supported by the results, with species responses differing between gradients. We argue that studies based on only one environmental gradient may cause misleading interpretations of the nature of biotic interactions in plant communities.

Poster E179

Factors contributing to the urban plant species richness

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Urban areas maintain high species diversity due to heterogeneous land use patterns and a significant percentage of non-native species. According to intermediate disturbance hypothesis, species diversity is high at an intermediate disturbance level due to a mix of good colonizer and good competitor species. Non-native species that successfully establish themselves to new habitats tend to be habitat generalists. Habitat destruction, fragmentation, soil nutrient enrichment and short-term disturbances all favor invasion by habitat generalists. Hence, non-native species take over space from native species, which promotes biotic homogenization. Urbanization is a threat to natural habitats and species. Natural habitat patches become isolated from each other and built environment makes the dispersal difficult and risky. For example nationally threatened vascular plants most commonly live in natural habitats like forests, shores or in mires in Finland. Earlier studies in the city of Tampere in Finland showed that the share of forest may be the most relevant indicator of urbanization, and even the small remaining natural fragments can help maintain the biodiversity of vascular plants. In this presentation, our aim is to identify areas with highest diversity of vascular plant species in urban area and determine main factors contributing to the species richness. In addition, we explore effects of urbanization to endangered species and harmful invasive species. The study area is the city of Oulu in northern Finland (65°01`N, 25°28E, ca. 400 km^2 in 2004). Data on plant species is provided by Botanical Museum of Oulu. The flora of the city of Oulu was monitored by using 1 km^2 squares (in total 406) as basic units in 1997–2004. Species were divided into different groups according to their red list status and invasiveness. We use Corine Land Cover (CLC) 2000 to classify different land-use and habitat types. Different measures describing biodiversity, e.g. a number of species and a number of habitat types will be calculated. Spatial analyses will be conducted with ArcGIS. Kernel density estimation will be used to identify plant biodiversity hotspots and generalized linear models to analyze the main factors contributing to the diversity. According to our preliminary results, both the number of invasive alien species and endangered species correlate with the total number of species. 4,1% of the vascular plant species in Oulu were listed as endangered and 3,3% as invasive alien species. Further results will be presented in a poster at the upcoming Symposium.

Means, extremes or in-betweens: Which climate variables are the strongest predictors of plant traits?

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The strategies plants use vary hugely across different parts of the world – from the lush tall forests of the tropics to the tough little plants of arctic tundra. However, we know surprisingly little about global patterns in fundamental plant traits, and even less about which environmental variables drive these patterns. When ecologists include climatic variables in their analyses, they tend to focus on variables that give information about climate averages, such as mean annual precipitation and mean annual temperature. These variables capture information about the conditions that the plants experience most often. However, another intriguing possibility is that it may not be the "average" days that impose the strongest selection pressure on plant populations, but rather the extreme events such as floods, droughts and heatwaves.

We tested this idea using data for 22 plant traits from 447961 species-site combinations from all around the world, including 25354 species. The 14 climate variables included means (mean annual temperature and precipitation), extremes (extreme high and low temperatures, consecutive dry and wet days, maximum 5-day rainfall, and the length, frequency, and severity of heatwaves), and four "in-between" variables that describe conditions in the wettest, driest, hottest and coldest months.

Overall, extreme climate variables were the best predictor of ten plant traits, mean variables for five traits, and "in-between" variables for seven traits. The variable that was most often the best predictor of plant traits was maximum temperature (4 traits), followed by mean annual temperature and rainfall in the wettest month (3 each), then mean annual precipitation, rainfall in the driest month and the duration of the longest heatwave (2 each). The difference in predictive power between means and extremes was often striking. Minimum temperature explained more than five times as much variation in the proportion of deciduous species than did mean temperature, and maximum temperature explained more than four times as much variation in the proportion of nitrogen fixers as did mean temperature. Interestingly, temperature variables had overall stronger predictive power than did precipitation variables, and mean annual temperature was a better predictor of 17 of the 22 plant traits than was mean annual precipitation.

Climate means, extremes and in-betweens are all important. However, our results show that extreme events have a disproportionately strong effect on plant traits. The expected increased frequency and severity of extreme events under climate change are therefore likely to have a strong impact on plant ecological strategy.

Poster A52

Diversity and distribution of tree species along an elevational gradient at the southern limit of the Brazilian Atlantic forest

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Data about species diversity and distribution are central to investigate species ranges, occupancy-area relationships and patterns of rarity and endemism, as to promote conservation policies. Gathering these data can be challenging in biodiversity hotspots as the Brazilian Atlantic forest, where the high biodiversity is a consequence of the extreme environmental variation, with a broad range of latitudes and elevations, and multiple habitats and ecosystems. The moist forests of eastern coastal Brazil (Atlantic forest sensu scricto) have been the subject of ongoing investigations, but its northern and southern boundaries remain largely unknown, particularly its southernmost limit. In order to fill this knowledge gap, the diversity and distribution of tree-species along a sea-to-inland elevational gradient in the southernmost limit of the Brazilian moist coastal forest were analyzed. Trees were sampled in six plots established at ≈ 220, 420 (subtropical forest), and 700 m asl (cloud forest), and communities were described under diversity measures, whereas species were assessed for commonness and rarity, and endemism. Species distribution resulted in a hump-shaped elevational pattern, with the mid-elevation peak corresponding to 77 percent of the richness for the entire gradient. Despite this, non-parametric estimations suggest that if we captured total species richness it would decrease monotonically with the increase in elevation. A total of 23% of the 109 species occurred along the entire gradient, while 20.5 ± 1.3 percent of the species at each community were restricted to only one elevation. β-diversity values revealed constant species turnover rates along the gradient, though a strong drop in diversity occurred between the middle and upper communities. We found a continuous average of 30 ± 3 percent of locally rare species for each elevation over the complete gradient, but dominance increased monotonically. Our results suggest that some species are habitat generalists and others specialists, with both contributing to the high local diversity and species turnover. Fifty one species (47%) are endemic in Brazil and 41 occur only in the coastal Atlantic forest. Furthermore, about 37% of the species are coastal moist forest endemics, indicating that many of these endemic species have range limits as extensive as the southern boundary of the Atlantic forest. In order to better know species diversity and distribution of the Brazilian coastal moist forests, further investigations are necessary, and they should encompass the broad latitudinal and altitudinal variations, especially in the largely unknown limits of the Atlantic forest.

Selecting environmental variables for vegetation-types mapping

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In a top-down design, vegetation-types mapping can be approached with an environmental-based model, usually relying on two main premises: i) presence of different vegetation-types is mutually exclusive in the landscape, although ecotones might exist between them; ii) there is an ecological causation for the vegetation-types distribution in the landscape. Consequently, it is expected that, in some n-dimensional environmental hyperspace (where each axis corresponds to each of the n environmental variables), the vegetation-types known occurrences can be plotted and, at least partially, separated from each other.

In the framework of variable selection, we propose to use recently published indices based on a combinatorial separability notion, which give insight on how deep the points of a cluster occur in the convex hull of other cluster. Using such indices we can quantify, namely: i) the separability of pairwise comparisons between vegetation-types and ii) the overall separability between all the vegetation-types simultaneously. Therefore, for a given dimensionality n, we can assess how different sets of environmental variables perform in separating the vegetation-types in the respective environmental hyperspaces. In this way, and under the aforementioned premises, we assist environmental variables selection, searching the combination of n variables that produces the greater overall separability, i.e. diminishing the environmental superposition of vegetation-types in the environmental space, which is expected to produce smaller ecotones between vegetation-types on the geographic map (model output). Furthermore, pairwise separabilities between vegetation-types can also be analysed, giving further information and permitting to check for the consistency of the selected variables.

We illustrate and discuss this variable selecting procedure using georeferenced locations of four forest-types from the Douro Demarcated Region (Portugal), where Port wine and other Douro wines are produced, today classified as UNESCO World Heritage Cultural Landscape (Alto Douro Wine Region).

Poster A53

The mountain vegetation of the South Andes of Peru: Syntaxonomy, ecology, phytogeography and conservation

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The vegetation of the southern Andes of Peru (2000-5000 m), its species composition, the relation with environment and phytogeography has been studied. Apart from its scientific importance, the study is of interest for nature conservation and the megadiversity of both native and endemic. Plant communities of the zonal vegetation (deserts, scrublands, grasslands and subnival vegetation) of the Andean regions of Arequipa and Moquegua are studied. Several new plant communities are described, their value for the protection of endemic species is analysed and the importance of their conservation is highlighted. Especially, also, a better understanding of the ecological conditions is needed to be able to protect the plant communities which provide a habitat for the endangered biggest bromeliad in the world 'Puya raimondii'. This endemic species occurs in few localities in Moquegua, between 3800 and 4400 m (Montesinos 2011) and has been established as endangered by the IUCN (Lambe 2009). These large rosette communities enhance the diversity of of several annual and shrubs that occur, sometimes, unique in the Puya raimondii ecosystems, with many endemics.

The research is based on the Braun-Blanquet method (Braun-Blanquet, 1979). Fieldwork was conducted during the final part of the rainy season (March-April), allowing the recognition of most vascular species with revisits in June and July. For clustering TWINSPAN (Hill 1979) was used, and the table was ordered into a syntaxonomic table allowing the recognition of plant communities at the association and major units. DCA and PCA, CANOCO 5 (Ter Braak & Šmilauer, 2012) is used to explore the relation between species composition and environmental variables. Finally PC-ORD (McCune & Mefford 1999) for the interpretation of the results with dendrograms. In each relevé soil samples have been taken and analysed for different variables. Included also are: altitude, soil depth, inclination, rock percentage, vegetation cover (including % bare soil) and leaf litter.

The research provides an overview of the regional plant communities and will give insight in the environmental conditions. For nature conservation planning a framework of the variation in the vegetation including the respective site conditions is essential. This research provides necessary biological and ecological information concerning the vegetation composition, vegetation patterns, floristic diversity and endemism in different zonal Andean ecosystems. This information is needed to establish protected areas for nature conservation in the Andes and will be useful for management planning.

Effect of current and past neighborhood composition on plant response to competition

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Competitive interactions are one of the main processes shaping plant community structure. In particular, competitor identity is a major factor determining competition effect on plant individuals. In this study, we assumed that 1.) clonal plants may respond to their competitive environment at the very local scale (few centimeters) since they can display some intraclonal plasticity in their traits linked with their resource harvesting ability. This trait plasticity can be observed in the resource acquiring organ (ramet) morphology (specialization) and positioning (foraging). 2.) Due to differences in organ lifespan, traits characterizing ramet morphology may respond to current neighborhood composition whereas traits involving connection structures may respond to past neighborhood composition.

To test these hypotheses, we analyzed the competitive response of Elymus repens to the plant composition in its neighborhood at different time and spatial scales. We sampled an E. repens clonal fragment located in the center of experimental plots where four different types of plant assemblages in terms of species richness and growth forms were grown. Plant species spatial distribution was mapped for each plot using a fine-grained resolution grid at the beginning of the vegetative season the same year than the E. repens sampling (current neighborhood) and one year before (past neighborhood). Through GIS, we analyzed species frequencies in buffers from 5 to 25 cm radius surrounding the sampled clonal fragment for both campaigns.

Most of E. repens trait values depended on the plant composition of its neighborhood,but the scale of this dependency in time and space was trait-dependent. These depend on local scales: from 5 to 10 cm with a particular bimodale response in foliar traits. Neighborhood composition accounted for a greater part of plant trait variation in traits involved in resource acquisition and performance than in traits linked with ramet positioning. In addition, the latter category of traits was influenced by the most similar plant species whereas ramet traits were influenced by multiple species competitive neighborhood. This work has key implications in understanding plant response to competition as it demonstrated that trait plasticity is not integrative.

How mycorrhizal is vegetation and does it matter?

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Mycorrhizal symbiosis is an ancient and widespread phenomenon in the nature. Majority of terrestrial plants are assumed to be colonized by the mycorrhizal fungi. These fungi facilitate mineral nutrient uptake from soil in exchange for plant-assimilated carbon. Their importance in shaping plant distribution patterns has been generally acknowledged. However, one mayor caveat in our ability to understand the importance of fungal symbiosis in contributing vegetation patterns is our limited understanding of the mycorrhizal statuses of plant species. Several prominent publications report information concerning the mycorrhizal status of large sets of plant species. However, still surprisingly small proportion of potential host plants is covered. Even for one of the best studied regions in the world – Central Europe – available information about the mycorrhizal status includes less than one third of all species (a recently launched database called MycoFlor, Hempel et al. 2013). Although the mere recording of a plant species mycorrhizal status may not entirely reveal the mechanism how a plant interact with its symbiotic partner, it gives us the basis to understand large scale patterns in coevolution as well as reveal ecological relationships between plants, their symbiotic fungi and environment. MycoFlor distinct among three categories of plant species mycorrhizal status: obligatorily mycorrhizal, facultatively mycorrhizal and non-mycorrhizal. This allows testing the relationships between plant species mycorrhizal status, habitat characteristics, life-history traits and plant distribution patterns. In addition, based on this categorization it is possible to calculate cumulative mycorrhizal index of a plant community (mycorrhizal status weighed with biomass estimate of particular plant species in a community and summed over species). We analysed variation of cumulative mycorrhizal indexes across different ecosystems and/or along different environmental gradients in order to generalise quantitatively the importance of mycorrhizal symbiosis in different vegetation types. This kind of information enables to put forward and test new hypothesis about the functional role of mycorrhizal symbioses in ecosystems.

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Poster E180

Analysis of the national wetlands vegetation database

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The national wetlands vegetation database of South Africa consists of vegetation plots and various environmental parameters collected throughout the whole country. A provisional classification of the entire database of more than 5000 plots has resulted into eight main clusters that are further subdivided into communities. Vegetation classification and ordination are important tools for researchers and resource managers that help in understanding wetland vegetation and its drivers. In this study, multivariate statistical techniques were used to analyse data available in the database. Patterns formed by wetland vegetation and their associations with environmental variables are revealed. The aims of the study are to test for homogeneity within and heterogeneity among clusters of vegetation samples, summarise, and explore different patterns formed by wetland vegetation in relation to environmental factors and to identify indicator species in different clusters. The analysis of the vegetation database included verification of the provisional clustering of vegetation groups in eight main clusters, using cluster analysis. Ordination analysis to reveal patterns using non-metric multidimensional scaling (NMS), indicator species analysis to identify species that are characteristic for the communities, group testing using PerManova to contrast plant communities found in very similar environmental conditions, and lastly generalised linear modelling to determine response curves of common species. Analysis was performed using two statistical packages PC-Ord 6 and HyperNiche 2. For cluster analysis, Sorenson (Bray-Curtis) distance measure and Ward's linkage methods were used. Ordination analysis was carried out separately for plots with soil data and for the entire dataset. The most important and influential environmental variables for these communities are soil texture, HGM units, and wetness.

Hemiparasitic *Rhinanthus minor* effects on trait composition of grassland community

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Hemiparasitic plants have a strong ability to modify species composition of grassland communities. Both an increase and decrease of species diversity caused by these species have been reported and it is unclear to which extent hemiparasitic plants will affect trait composition and functional diversity of communities. *R. minor*, the most studied of these hemiparasitic plants, is expected to suppress mostly grasses and legumes, but many species may not follow this general pattern. To generalize the functional effect of *R. minor* on communities, we established a two-years field experiment in which we combined, in factorial design, the removal of *R. minor* with fertilization, in order to investigate the effect of *R. minor* on functional composition and functional diversity. The species composition was evaluated as biomass of individual species, for which traits were acquired from existing databases. Trait community weighted means (CWM) indicated that *R. minor* suppressed clonal species with long (>0.25m) lateral spread and tall species with high leaf dry matter content (LDMC). The patterns were underlined by *R. minor* causing the suppression of some grass species (mainly *Festuca rubra*) in favor of forbs species (mainly *Plantago lanceolata*). As such *R. minor* did not affect CWM values within grasses or within forbs species, which indicates that changes in CWM were caused mostly by a shift in grass to forbs proportion only, not a functional replacement within these life forms. While diversity (expressed as number of species and Simpson index) of the whole community and diversity of grass species was unaffected by the treatments, Simpson diversity of forbs was reduced in presence of *R. minor*. Similarly, functional diversity (Rao quadratic entropy) was unaffected by the *R. minor* removal, neither when computed on whole community nor when computed within grasses and forbs separately. The results indicate a stronger effect of *R. minor* on the identity and functional characteristics of the dominant species rather than on species and functional diversities, challenging the general notion of hemiparasitic plant effects on biodiversity.

Poster A54

Determinants of tree species beta diversity in Brazilian Atlantic forest: are there differences among strata and forest formations?

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Understanding the relative importance of environmental factors and spatial distances influencing plant community patterns in tropical and subtropical forest remains a challenging topic to be solved. The relationship among such set of variables to niche and neutral driven processes is also still under large debate. Here we investigated the proportional influence of soil variables (environment) and spatial distance on tree species communities of two forest formations in the southern Brazilian Atlantic Forest (Atlantic rainforest – RF, and Araucaria forest – AF), considering three forest strata (upper, medium and lower). The objectives are to assess beta diversity and the relative influence of environmental and space in explaining variation of tree species turnover, considering two scales and differences among strata. Eight locations, each one with 12 sampling units of 100 m², were sampled according to three strata: the upper stratum included trees with diameter at breast height (DBH) ≥ 10 cm, medium contained those between 1 and 10 cm DBH, and the lower included trees with less than 1 cm DBH. The proportional influence of environment and space was accessed by variation partitioning analysis, while the beta diversity patterns were analysed through multivariate dispersion. The forest formations differed in species composition and total richness. 96 and 78 tree species were found respectively in RF and AF. The number of species/m² didn't differ between both forests, but the beta diversity of RF was significant higher than AF for the upper and lower strata. The proportional influence of environment and space on the variation of species turnover differed among forest formation and strata. In the broader scale, the fractions of soil variables and space were significant and very similar among all strata (3 to 6% of the variation) and the fraction of [b] (spatial structured environment) accounted up to 20% of explanation. In the local scale, the AF showed similar patterns to all strata, being the space more important than the environment especially for the upper strata (10,5 and 1,5% respectively). Nevertheless, RF didn't have significant results to the upper stratum, and to the medium and lower strata just the spatial fraction was important (6 and 4% respectively). The [b] fraction was mostly expressive to the medium stratum (16%) of the RF. The most impressive is that a great portion of variation remains undetermined for such Atlantic Forests, leading to unclear patterns of tree species turnover and else beta diversity of plant communities.

Poster E181

Coppice neglect: impact on forest diversity and drivers of change

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In studies of European landscapes, there is an urgent need to overcome the separation of natural and cultural sciences, and to integrate geography, landscape ecology and environmental history to better describe landscape socioecological processes. Coppicing was commonly practiced in European broadleaved forests for centuries. In highly populated areas it provided regular supply of firewood and construction wood in coppicing with standards. This practice started to loose its importance after the substitution of wood with fossil fools. Coppicing had large influence on forest functions, and we can therefore assume high impact of its neglect on the forest diversity and functions. In our study, we investigated two karst regions of oak coppice forests of the Czech Republic. Using archival sources such as forest maps and forest management plans we analyzed temporal and spatial patterns of forest change (management, structure and species composition), and socioeconomic forces behind these processes. Our goal was to relate the environmental history to the present state of forests, and to identify the driving forces of change. We detected a pronounced increase of forest age and lowering of forest age diversity. The impact of such aging on herb species diversity was assessed using historical phytosociological releves. Knowing the date of releve acquisition, the age of forest stands in time of the sampling was derived and used as explanatory variable. Ecological conditions of sites were derived from Ellenberg indicator values. Shannon-Wiener index of diversity and Ellenberg value for nutrient were significantly negatively related with age of forest stands, whereas for Smith-Wilson index of evenness we found significant positive relation. This indicates that reduction of young forest stages lowers the forest diversity (especially that of light-demanding species). Although after WWII, the coppicing was ceased completely, the process of coppicing abandonment was gradual. Some sites were abandoned already in the end of the 18th century while some were regularly coppiced till the1950s and structure of such forests still bears signs of previous managements (overgrown coppices and remnants of coppice stools, and standards with characteristics crown architecture). The pattern of abandonment was related significantly to the slope steepness and soil quality, parameters limiting for forest management. Neglect of traditional coppicing management has strong impact on biodiversity, and threatens the continuity of historical landscape forms and protected species. Our study can serve as a knowledge base for the rising efforts of coppicing re-establishment for biodiversity conservation purposes in Europe.

Conservation of biodiversity in semi-natural grasslands in Japan

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Aso mountains situated in central Kyushu is the largest active volcano in Japan. Surrounding the mountains is a vast secondary or semi-natural grassland, which has been shaped through years of traditional agriculture and grazing activities by local residents. This grassland landscape is a result of the oppression of the natural transition as a result of the active repetition of mowing, grazing and burning off the grasslands. Since the 1960s however, the expansion of conifer plantation as well as social and economic cultural changes has affected and reduced the habitat areas of grassland plant species. It is very important to investigate the plant species traits against the grassland managements for their sustainability. The variety of local anthropogenic activities which have helped create the unique Aso grassland cultural landscape is attributed to long historical usage by humans. The Bon tradition (a Buddhist event in which each household invites home their ancestors' spirit) of picking flowering plants named "Bon-bana" is one such major human impact which has encouraged to form the current grassland biodiversity including grassland insect fauna. This study focused on finding management methods to conserve biodiversity of these semi-natural grasslands. First of all, a list of all plant species in the area was drawn up by referring to several publications including vegetation science and Bon-bana floral research, and conducting field surveys in the meadow, pasture and abandoned sites in Kario grassland area. Total number of vascular plant species was 183 in total of 100 quadrats (1 ×1 m in size). All plants height and coverage were also recorded for species dominance. By analyzing the life traits of component plants, several types of life traits were found among the managing grassland. The Red Data Book compiled by the Ministry of the Environment, the Kumamoto prefectural RDB and a national brochure of the grassland improvement project held in this area were also studied. Research findings showed that over one-fourth of plant species were already recorded in RDBs and Bon-bana lists, and it was confirmed that several actions such as maintaining low-intensity farming, must be immediately taken to conserve this semi-natural grassland.

Poster D149

Distributional pattern of alien species along the road side in alpine and sub-alpine area of Mt. Fuji

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In alpine and sub-alpine area of Mt. Fuji, many alien species have invaded to both side of a car road (Fuji Subaru Line) and mountain trails. We investigated distributional pattern of alien species every 25m at both side of the car road and mountain trails. Alien species defined in this study were species originated from foreign country, and native species in Japan in which original distribution were lower altitudinal area in Mt Fuji. A car road was paved asphalt. The car road site were consisted in bare ground of basaltic scoria, slope of basaltic lava and hardened slope with concrete. Fifty-six alien species were recorded in 2012. Species richness of alien species was higher at both side of car road compared with mountain trails. Fifty four species were recorded at a car road. Only Six to Sixteen species were recorded at mountain trails. The most popular alien species were *Artemisia indica* and *Festuca glauca*. Twenty-three species were artificially introduced species. These species were sprayed on road sided slope to protect land slide of slope of the road. At mountain trails, species richness of alien species were higher at the parking which is the end of the car road. Few species invaded on mountain trail running through the native vegetation of this area. The most dangerous alien species in alpine and sub-alpine area were *Salix bakko* and *Artemisia indica*. Those two species were seldom recorded at mountain trails in which both side of the trail were native vegetation. Even more no species were recoded in native vegetation of this area. Thus we have to remove the individuals of alien species by human power. In next study we have to be quantitatively evaluated of alien species. We also have to continue the monitoring of alien species in this area.

Poster D138

An analysis of forest ecosystem structural variation in Scots pine dominated stands: a methodolocical consideration based on the Estonian Network of Forest Research Plots

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The changes in regional or global biological diversity or spatial distribution reflect the reactions of organisms in these ecological systems to modified environment conditions. The changes in the behavior of any single species, taxon or geographic region have a number of possible explanations including not only climate change but also globally extensive human-induced land use changes.

Disturbances operate at multiple spatial scales and often disturbances at different scales interact, producing multi-scale habitat diversity, from microhabitats to landscape. In the past, when methods for growth and yield prediction of a given tree species were used, it was assumed that tree growth besides other factors (stand density, age of the stand and management regime, genetics of the trees, etc.) is largely predefined by site productivity. Site productivity, in most cases defined as a potential for timber production, for a certain tree species, was often considered consistent, providing a specific growth pattern and not changing much over the time. However, recent studies show that long-term growth trends have changed and provide strong evidence on tree growth acceleration.

In current study we focus on analysing forest ecosystem in basic structurally similar functional units built up by trees, ground vegetation and soil. For the study of these three structural units, the combined monitoring of single tree growth varables, the detiled inventory of ground vegetation and mechanical and chemical description of soil has been started in the Estonian Network of Forest Research Plots (ENFRP) in Estonia. In this study the records of 130 Scots pine dominated plots on *Vaccinum* sites have been studied. The stand variables include measures of potential tree growth, tree height and height/diameeter relationship derived from the single tree inventory data. A ground vegetation inventory based on the 400 „point" descriptions on each plot. And soil organic matter measured on site but also with chemical analysis from composite samples of the plots. We aim to present the theoretical framework for analyzing forest ecosystem functional units in the context of natural and anthropogenic disturbamces. We distinguish the range of variation within the site type following the known history of these particular forest stands.

The aim of the study is to develop the methodological basis and practical methods from tree to stand level assessment of the influence of current development in natural and managed forests with the recognition of the effect of previous disturbances to current forest composition and structure.

Poster C84

Response of understory vegetation to thinning in hinoki cypress plantations in southwestern Japan

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With growing interest in ecologically sustainable forest management, there is increasing need for knowledge on biodiversity in forest plantations. Understory vegetation accounts for a substantial portion of plant species diversity in forests. In forest plantations, the species composition and diversity of understory vegetation can be affected by thinning, an important forestry practice that changes the stand structure. This study aimed to elucidate the response of understory vegetation to thinning and its underlying processes in hinoki cypress (*Chamaecyparis obtusa*) plantations in Shikoku, southwestern Japan. We examined the cover, species richness and composition of understory vascular plants at two plantation sites over four growing seasons after the thinning. To evaluate seed availability of woody species at the study sites, we assessed the soil seed bank using the seedling emergence method and measured seed fall using seed traps.

The species richness of the understory plants markedly increased in 2008, the first growing season after the thinning treatment, in the plots with lower initial species richness. Among the woody species recorded only in the thinned plots, around 35% were also detected in the soil seed bank but were less prevalent in seed fall. The total cover of vascular plant species in the thinned plots gradually increased at both the sites after the thinning treatment. However, the cover and species richness of woody and herbaceous species reached the maximum in 2009 and began to decrease in 2011 at one of the sites that showed rapid canopy closure. Non-metric multidimensional scaling (NMDS) showed that the species composition in the thinned plots in 2008 and 2009 was substantially different from the initial composition in 2007 at both the sites. The species composition in the thinned plots was characterised by woody species that were detected in the soil seed bank, such as *Rubus* spp., *Mallotus japonicus* and *Araliaelata*, as well as herbaceous species such as *Lysimachia japonica*. In 2011, however, decrease in the prevalence of some of these species in the thinned plots caused a shift towards the initial species composition. These results suggest that pioneer species regenerated from the soil seed bank play a substantial role in the early stages of understory vegetation development after thinning in these conifer plantations; however, their role lasts only for a few years because they rapidly decrease with increasing canopy closure.

The role of long-term environmental records in the biodiversity conservation of the Canary Islands

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The Canarian archipelago is one of the most biodiverse areas within the European Union and is part of the Atlantic island biogeographical region of Macaronesia (with Azores, Madeira, Selvagens, and Cape Verde). Much biodiversity conservation policy is concerned with maintaining or restoring the landscape to its most biodiverse and/or "natural" state. Long-term data can expand the temporal frame of conservation land-use policy and has much to offer in light of planning for the uncertainty of climate change which is likely to manifest over longer time-scales. The biota of the archipelago has been recently a focus for palaeoecological studies, particularly using fossil pollen and charcoal time-series which are kept in sedimentary profiles from (former) lakes. Here, we report a long-term vegetation dynamics (the last 9600 cal. years) of a higher elevation monteverde forest (e.g. *Laurus*, *Morella*, and *Erica*) on Garajonay National Park in La Gomera (Canary Islands). This forest, with trees 30 m high, has a complex biogeographical history and is considered to be a Tethyan relictual flora that colonized from the Mediterranean region during the late Tertiary. Our results do not show a strong indication of past human impacts of the summit habitat when the first inhabitants arrived to the island approximately 2500 year ago. However, the vegetation time-series showed a monteverde community change at c. 5500 years ago involving a compositional shift change of roughly 15% of the average Bray–Curtis dissimilarity. This is important in terms of conservation management as this National Park is protecting one of the largest monteverde forest patches and one that is a truly ancient with a predominantly natural legacy. Thus which are the conservation implications for the National Park? We will discuss about habitat resilience in La Gomera and the effects of past fire regimes and the plant sensitivity to drier climates.

Nature versus culture: the impact of forest management history on the biodiversity of ground vegetation

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What are the main effects of forest management history on biodiversity of ground vegetation in boreal spruce dominated forests? In order to give an answer to this question we have collected ground vegetation data from four areas with natural old growth forest stands (Bringen, Grytdalen, Gutulia and Rausjømarka) and from four areas with older silviculture stands (Asker, Bergermoen, Bærøe and Gaupen). All eight sites are positioned in SE Norway.

At each site, data on ground vegetation was recorded according to a restricted random sampling procedure, using subjectively placed macro plots with randomly placed 1x1m plots (Asker 60 plots (year of recording: 2011), Bergermoen 54 (2009), Bærøe 60 (2012), Gaupen 84 (2008), Bringen 50 (2006), Grytdalen 50 (2011), Gutulia 50 (2009) and Rausjømarka 50 (2008)). For each 1x1m plot percentage cover and frequency in 16 subplots was recorded for all species, as well as several environmental variables such as soil chemistry, topography and tree layer data.

Preliminary results from a comparison of species numbers using Kruskal-Wallis test indicated a significantly higher number of species in natural old growth forest stands relative to older silviculture stands. The old growth forests also contained a significantly higher number of ericaceous species, more hepatic species, and more lichen species. Further analysis will include appropriate statistical- and multivariate methods to compare the abundance of species and species groups, as well as species composition and environmental conditions.

Poster A55

Phytosociology and ecology of the high alpine to subnival scree vegetation of N and NW Iran (Alborz and Azerbaijan Mts.)

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Questions: The vegetation of high alpine and subnival scree habitats in Iranian mountains has been poorly investigated so far despite the high rate of narrowly distributed vascular plant species and the expected vulnerability of these ecosystems to global warming. Which plant communities occupy these ecosystems and what is their syntaxonomical position? Which environmental factors determine the species composition of these habitats?

Location: Alborz and Azerbaijan Mountains in N and NW Iran.

Methods: A total of 141 phytosociological relevés have been collected from 3200 up to 4800 m a.s.l.

This data set was classified using the TWINSPAN algorithm, and the numerical classification was translated into a syntaxonomic system. Floristic differences between vegetation types were evaluated by Detrended Correspondence Analysis (DCA). We determined the means and standard deviations of measured environmental and vegetation parameters for all associations. Differences in the major environmental parameters among associations and alliances were analysed using ANOVA and post-hoc tests. Moreover, we determined the mean cover percentage of life forms in all associations. Results: All high alpine and subnival scree communities are arranged in one class (*Didymophyso aucheri-Dracocephaletea aucheri*), two orders (*Physoptychio gnaphalodis-Brometalia tomentosi, Didymophysetalia aucheri*), three alliances (*Elymo longearistati-Astragalion macrosemii, Erigerontion venusti, Didymophysion aucheri*) and 10 associations, which are new to science except one association. The territory of the class extends from Alborz to NW Iran and probably to E Anatolia, Transcaucasia and the Zagros mountains. Altitude, aspect and edaphic qualities are the major ecological factors influencing the species composition and the vegetation mosaic.

Conclusions: Our study introduces a formal syntaxonomic classification of the scree vegetation in high altitudes of Iran, thus providing a scheme for ongoing ecological surveys and monitoring programs to assess the impacts of climate warming and of human land use on these unique ecosystems.

Poster C98

Vegetation changes recorded in sandstone rock shelters with long stratigraphic sequences (Paleolithic-Medieval period) in Northern Bohemia

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This study is focused on an anthracological and macroremains analysis of Paleolithic-Medieval layers in the sandstone areas of North Bohemia in the Czech Republic. The palaeolithic occupation layers have been discovered below the Mesolithic. At the Údolí samoty , Konejlova and Kristova jeskyne rock shelters we documented a thick and complex stratigraphy, while at the Janova zátoka rock shelter we recorded just a thin sedimentary sequence. Although the Údolí samoty and Janova zátoka rock shelters provided continuous stratigraphic and environmental records for the first time from the Late Glacial to the Holocene in this region, no significant changes in settlement and resource exploitation strategies could be observed. These foragers were optimally adapted to the versatile landscape of sandstone plateaus and canyons throughout the climatic change in order to exploit changing vegetational resources.

At Údolí samoty, the presence of hazelnut shells was recorded continuously from an Aeneolithic layer (100 – 120 cm) to the Late Paleolithic (300 – 320 cm). A continuous record of hazelnut shells is important evidence of human activity in this type of environment. The Paleolithic layers are characterized by low species diversity, anthracomass and the amount of hazelnut shells. The surrounding vegetation best corresponds to an open pine forest where the species composition indicates unfavourable enviromental conditions. In the Modele Mesolithic, the hazelnut shells and anthracomass show the highest quantity. The high amount of hazelnut shells probably correlates with the frequency of human occupation in the rock shelters. The same layers also show the highest species diversity. Surrounding vegetation can be reconstructed as a mosaic with the presence of sparse pine forests, species-rich oak forests (so called Quercetum mixtum), hazel shrubs and early successional vegetation with aspen and birch. The highest amount of oak charcoal is recorded from the upper Mesolithic period to the beginning of the agricultural period. During this period the presence of hazelnut shells is significantly reduced. Beech charcoals are abundantly recorded in the Bronze Age and during the La Tène period. In Medieval layers, a significant decline of species diversity and increasing representation of Scots pine is recorded.

Poster E182

Phytodegrading potentials of *Cajanus cajan* Mill sp. and its associated Bacteria, polluted with crude oil

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The objective of this paper is to investigate the phytodegradative potentials of *Cajanus cajan* and its associated Bacteria. In order to simulate spillage, 0.1, 0.2, 0.6 and 3.0% v/w of crude oil were used to pollute soil planted with seeds of *C. cajan*. These treatments were repeated in soil without seeds and the control had no crude oil pollution. Seven months after pollution, total petroleum hydrocarbons (TPH) were determined for all the soil samples, leaves, stems and roots using gas liquid chromatography. Bacterial count, isolation and identification were carried out on the soil rhizosphere and the roots using standard methods. The results showed that percentage TPH degraded in soil planted with *C. cajan* was 99.90%, 99.80%, 99.85% and 99.88% for 0.1, 0.2, 0.6 and 3.0% v/w of crude oil contaminations, respectively. *C. cajan* alone degraded 0.07%, 0.02%, 0.36% and 0.46% of TPH for 0.1, 0.2, 0.6 and 3.0 %, respectively. TPH was not detected in the leaves, stems, roots and in the control. The Bacteria identified were *Staphylococcus* sp., *Bacillus* sp., *Pseudomonas* sp. and *Clostridium* sp. *C. cajan* might have enhanced the phytodegradation of the crude oil by stimulating the proliferation of these microorganisms. Thus, this plant may be used for phytoremediation, which is an environmentally friendly, cheap method of depolluting a contaminated site.

Biotic and abiotic drivers of species distribution and richness on dynamic uplifting beaches

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Traditional species distribution modelling and the generality of the dynamic equilibrium model (DEM) have recently been challenged by studies highlighting the importance of biotic interaction, species functional groups and spatial and time scales. Relatively simple uplifting beaches are highly dynamic systems that often comprise extreme environmental gradients, and therefore are an exceptional setting for studying the simultaneous effects of key biotic and abiotic factors on the richness and occurrence of species at fine spatial scales.

We analysed the simultaneous effects of primary succession, disturbance, productivity, biotic factors and their statistical interactions on plant species distribution and richness in boreal uplifting beaches. The main questions were: 1. What are the effects of abiotic and biotic factors and their statistical interactions on total species richness? 2. Do these effects differ between functional groups, particularly between specialists and generalists?

An in-depth analysis was based on a comprehensive and systematic vegetation survey of 40 boreal uplifting beaches on the Finnish Baltic coast (n = 519 observations of vegetation and environmental variables). Species richness was modelled using generalized linear mixed modelling, and species distributions using cross-validated generalized boosted models. Results were analysed for the vegetation as a whole and separately for functional groups.

Total plant species richness responds negatively to increasing disturbance and positively to succession and productivity, with statistical interactions being highly important. The response of specialist species richness to succession and disturbance is unimodal, while that of generalists is monotonically positive and negative, respectively. The predictive power of species distribution models is improved by the incorporation of biotic variables, with vascular and cryptogam species (showing different competitiveness and stress tolerance trade-offs) on average having contrasting responses to the dominant vascular plants.

Succession, disturbance, productivity and biotic interactions drive species occurrence patterns and community richness in uplifting beach environments. These results are consistent with the predictions of the DEM for dynamic environments: generalist species richness increases during the course of succession and with decreasing disturbance and increasing productivity while specialist species thrive under intermediate disturbance and in the mid-successional stage. Disturbance generally increases species richness in the most stable and productive locations. In contrast to expectations, there is no general dominance of facilitative effects in this system, with both positive and negative biotic effects associated with the dominant species. Our results highlight the importance of trade-offs which causes differences between species in terms of environmental driver responses.

Disturbance by large herbivore alters relative importance of ecological process influencing assembly pattern in heterogeneous meta-communities

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Over the last century, some of the large herbivore had increased in range and population at national scale, becoming major driver causing drastic change in plant communities. Alteration of disturbance regime caused by large herbivore has potential to affect relative importance between deterministic and stochastic process in community assembly, and may cause a systematic loss of biodiversity across scale. Since meta-communities in the 'real' world are usually structured by multiple environmental filters operate at different scale, compositional turnover along each environmental gradient may differently respond to disturbance.

To assess how disturbance caused by large herbivore affects relative importance of ecological processes influencing the assembly pattern of meta-community, we used community composition data derived from 92 survey plots in Chichibu-Kai-Tama National Park in central Japan. In this region, Sika deer *Cervus nippon* have drastically increased in late 1990s. Survey plots were initially sampled in 1979-1985, earlier than deer overabundance, and re-sampled in 1999-2006.

To test the significance of change in community assembly pattern between two survey periods, we took null modeling approach. We calculated Raup-crick metric as indicator of dissimilarity in species composition between pair-wise communities. Null modeling approach revealed significant change in community assembly pattern, from deterministic to more stochastic. To quantify the contribution of the environmental and spatial variables on species composition within each survey period, we performed variation partitioning based on CCA. The results of variation partitioning demonstrated diminish in importance of environmental factors and increase in importance of spatial factor to explain variation of community composition. To test the significance of change in compositional turnover along ecological gradient between two survey periods, we fitted generalized linear mixed models (GLMMs). Response of compositional turnover rate differed among environmental gradients: regression slope decreased in habitat and topographic gradients, while no significant change observed in altitude and spatial gradients. This result was consistent with the response of ratio of generalist and specialist along environmental gradients, measured by Levin's standardized measure of niche breadth. Relative importance of specialist decreased in habitat and topographic gradient, while relative importance of specialist increased in altitude gradient. We provided evidence that intensification of disturbance caused by large herbivore weakened deterministic assembly pattern, leading to more stochastic pattern related to spatial process. Our result emphasized importance of conserving specialists which represents local environment such as habitat and topography, to maintain biodiversity at regional scale.

Vegetation geography of mountain vegetation of central Japan viewed from vegetation of martime-oceanic regions of northeastern Asia

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Keywords: Fagus crenata forest, Picea. Sect. Picea forest, Abies mariesii forest, Amphi-Pasific, Broadleaved grass land, Humid climate, Northeastern Asia

Vertical vegetation of Japanese mountains contains diverse vegetation types such as *Fagus crenata* forest, *Quercus mongolica* forest, *Abies mariesii* forest, *Betula ermanii* forest, *Pinus pumila* scrub. They develop under per-humid climate which is characteristics among Japanese mountains. This study focuses on the vegetation geography of those vegetation types with a comparison of vegetation of martime-oceanic regions of northeastern Asia. The aims of the study are: 1) to understand the floral composition and geographical distribution of the vegetation types, and 2) to reconstruct vegetation history of Japanese mountains. Montane region contains *Fagus crenata* forest and *Quercus mongolica* forest. Subalpine region consists of two sub-regions: tall tree region and shrub region. Major vegetation types of the tall tree region are: *Abies mariesii* forest, *Betula ermanii* forest, broadleaved herbaceous community. Major vegetation types of the shrub region are: *Pinus pumila* scrub, snow-bed dwarf shrub, wind-exposed dwarf shrub, alpine desert. Among them *Fagus crenata* forest and *Abies mariesii* forest are endemic vegetation to Japan, while others have ecologically relevant vegetation of martime-oceanic regions of northeastern Asia. *Quercus mongolica* forest corresponds to *Picea*. sect. *Picea* forest with some species of deciduous broadleaved trees developing on humid stands of Sikhote-Alin. *Betula ermanii* forest exactly corresponds to that of the Kamchatka peninsula. Broadleaved herbaceous community is originated from understory of *B. ermanii* forest in the Kamchatka. *Pinus pumila* scrub can be considered to a southern expansion of understory of *Larix gmelinii* forest in Eastern Siberia. Snow-bed dwarf shrub and wind-exposed dwarf shrub both are relevant vegetation to those of dwarf heath vegetation in northern Kuriles. Geographical distribution of the major components of those vegetation types are: 5 of Okhotsk type, 3 of East Siberian type, 2 of Bering type and 1 of circum polar type. This finding suggests that vegetation of alpine-subalpine regions o Japanese mountains develops under humid-per-humid climate of northern Pacific. Subalpine vegetation of Japanese mountains in the Last Glacial contained also humid-per-humid components, and offered them refugia, in contrast with the generally accepted view that in the Last Glacial Japanese mountains experienced cold-dry continental climate and had continental arid vegetation types.

Effects of increased biomass removal on biodiversity and species composition in Norwegian forests

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Use of forest resources for bioenergy is expected to increase considerably in Norway in the near future. Forest residues (branches and tops) are likely to be harvested for bioenergy use, possibly leading to nutrient depletion and increased risk for future nutrient imbalance, reduced forest production and changes in biodiversity and understory species composition. In order to analyse these effects, two research sites were established in boreal Norway spruce (Picea abies) forests; in 2008 at Tjerne (SE Norway) and in 2010 at Vindberg (SW Norway) as part of the research project "Ecological consequences of increased biomass removal from forests in Norway" (2008-2013). Treatment plots for (1) whole tree harvesting (WTH) and (2) conventional harvesting (CH) were placed in both sites; 12 plots sized 20 X 20 m^2 at Tjerne and 10 plots of size 10 X 10 m^2 at Vindberg. Within each treatment plot, 1m^2 vegetation plots were randomly placed and permanently marked (84 at Tjerne and 70 at Voss). The logging was performed in 2009 at Tjerne and in 2011 at Vindberg. At CH plots, only stems were harvested and the slash was left behind and spread out on the treatment plots, while at WTH plots the stems were removed but the slash was collected and left in 1-4 piles for 6-10 months before they were harvested; leaving the remaining areas in the WTH plots without or with relatively small amounts of slash.

For all species, percentage cover was recorded in all 1 m^2 plots. At each site, pre- and post-harvest recording of vegetation and measurements of environmental variables were made in 2008 and 2010 (Tjerne) and 2010 and 2012 (Vindberg). At each vegetation plot, several environmental variables were recorded prior to harvesting (topographical, soil physical, soil chemical and tree variables).

The significance of harvest-induced changes in plant biodiversity was investigated by means of Kruskal-Wallis tests. At both sites, species numbers were significantly reduced for some species groups. Effects of harvesting on species composition were analysed by means of Canonical Correspondence Analysis (CCA) and Redundancy Analysis (RDA), using the environmental variables mentioned as co-variables. For both sites the amount of remnant slash and the more uneven distribution of slash at WTH plots (due to the piles) had a considerable influence on both species diversity and species composition.

Multi-year changes are expected, but could not be followed up due to the short observation period.

Biotic interactions limit species richness in an alpine plant community, especially under experimental warming

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The determinants of local species richness in plant communities have been the subject of much debate. Is species richness the result of stochastic events such as dispersal processes, or do local environmental filters sort species into communities according to their ecological niches? Recent studies suggest that these two processes simultaneously limit species richness, although their relative importance may vary in space and time. Understanding the limiting factors for species richness is especially important in light of the ongoing global warming, as new species establish in resident plant communities as a result of climate-driven migration. We examined the relative importance of dispersal and environmental filtering during seedling recruitment and plant establishment in an alpine plant community subjected to seed addition and long-term experimental warming. Seed addition increased species richness during the seedling recruitment stage, but this initial increase was cancelled out by a corresponding decrease in species richness during plant establishment, suggesting that environmental filters limit local species richness in the long term. While initial recruitment success of the sown species was related to both abiotic and biotic factors, long-term establishment seemed to be controlled mainly by biotic factors, indicating an increase in the relative importance of biotic interactions once plants have germinated in a microhabitat with favourable abiotic conditions. The relative importance of biotic interactions also seemed to increase with experimental warming, suggesting that increased competition within the resident vegetation may decrease community invasibility as the climate warms.

Do intra-specific and-between community variability of leaf traits correspond? An example from alpine plants

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Functional plant traits, such as specific leaf area (SLA) and leaf water content, change within and between species in relation with ecological properties of their habitats. Weighted mean (WM) trait values based on plant biomass are useful parameters for functional structure comparison between communities with different floristic composition. Changes in trait WM depend on 1) floristic and dominance structure 2) intra-specific variability of plant traits. Our objective was to assess relations between intra-specific and WM traits in alpine communities in NW Caucasus.

Leaf traits (leaf blade thickness, wet and dry mass of a leaf, water content under saturation, and SLA) were measured for 120 plant species in 4 communities - alpine lichen heaths (ALH), *Festuca varia* meadows (FM), *Geranium–Hedysarum meadows* (GHM) and snowbed communities (SBC). Seventeen species were studied in two or more communities. WM was calculated on the base of aboveground biomass estimation.

In a toposequence from snow-free ridges to depressions (ALH–FM–GHM–SBC) WM wet and dry mass of a leaf increased from ALH to GHM and decreased from GHM to SBC. Most of the studied species followed this pattern. Noticeable exceptions are low, mainly rosette plants (*Campanula tridentata, Minuartia aizoides*), which have smaller leaves in the highly productive GHM.

The highest WM leaf thickness was noted for FM, the least for GHM and SBC. Most of the studied species, except dominant *Festuca varia*, did not follow this rule; they often have lower leaf thickness in FM than in other communities. So WM of this trait depends on the dominant species and does not correspond to intra-specific variability of other common species.

WM for SLA and leaf water content had minimal values for FM, but in general increased from upper to lower meso-relief position (ALH<GHM<SBC). In this case, intra-specific trends are opposite to trends of weighted community means, e.g. most of the studied species increased SLA from ALH to FM and decreased SLA from FM to GHM. So, the low WM values for SLA and water content in FM are explained by high Festuca varia abundance in this community.

We conclude that intra-specific and between community variability of leaf traits often do not correspond. Leaf parameters of the dominant species mainly determine WM community values, which can change opposite to the individual responses of the subordinate species.

Fine root dynamics of *Quercus settata* forest: estimation by continuous inflow approach and recognition of root size classes

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Fine root dynamics of terrestrial ecosystems is important in understanding global carbon budget because carbon accumulation in and flux through belowground organs are major components of carbon dynamics; yet they have not been fully understood. Fine root dynamics has been quantified with soil core techniques by the use of "decision matrix" for some time. However, it theoretically requires that fine root mortality, decomposition, and growth do not occur at once. They do occur simultaneously in nature, demanding an improved method for estimation. The "continuous inflow estimate" was proposed recently as one of such improvements. We applied this new approach to a deciduous oak forest of *Quercus serrata* in central Japan with two soil core techniques (ingrowth cores and sequential soil core samplings), and by recognizing two size classes of fine roots and inter-class mass transfer. Results with sequential soil core samplings suggested that fine root production was 1.33 g m^{-2} day-1 when the size class structure was not recognized, but it was 1.51 g m^{-2} day-1 when thinner (diameter $\leq$ 1 mm) and thicker (1< diameter $\leq$2 mm) fine roots were distinguished, with the latter 14% greater in value. Ingrowth cores provided an overall estimate of fine root production of 0.57 g m^{-2} day-1. That by sequential soil cores (1.51 g m^{-2} day^{-1}) was 2.6 times greater than the ingrowth cores. This difference was due to insufficient time for the thicker fine roots to grow inside the ingrowth cores within six months of experiment, and their inability to account for mass increment from growth of pre-existing fine roots in the beginning of the experiment. Overall, size-class analysis of fine root dynamics revealed that sequential soil cores are considered better represent fine root production than ingrowth cores for these characteristics.

Cryptogamic communities in strongly disturbed habitats – a case study of post-smelting dumps

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The development of vegetation in strongly disturbed and affected by human activities habitats, especially those contaminated with heavy metals, is extremely difficult due to the limited pool of species which could potentially colonize them. Ecosystems functioning under stress conditions have resulted in the formation of distinctive communities with a specific species composition. Adverse habitat factors generally reduce vascular plant vegetation and favor cryptogamic species which are known as the first effective and rapid colonizers. Therefore, cryptogams, mainly lichens and bryophytes, play a fundamental role in the initial stages of spontaneous succession not only in natural, but also anthropogenic sites. This study concerns pioneer communities developing in strongly contaminated post-smelting dumps where the process of colonization and natural regeneration is extremely sluggish and begins with an entirely sterilised habitat. Nine post-smelting slag dumps deposited in the environs of the Upper Silesian Industrial Region, the most polluted region in southern Poland, were investigated. Lichens, bryophytes and vascular plants were examined in 43 study plots of 1 × 1m representing homogenous patches of vegetation. The constancy and cover index for each species were determined. Based on this general analysis, relevés with similar cryptogamic communities published from disturbed habitats in northwestern Germany and natural sand dunes on the lower Dnieper in southern Ukraine were chosen for comparative purposes. Hierarchical cluster analysis was employed to verify the similarity between the relevés. The obtained results show that the communities from anthropogenic sites correspond with each other in terms of the presence of some cryptogamic species. In contrast, any vascular plant species could be characterized by high constancy and their composition is rather accidental. The universal pattern of certain cryptogamic assemblages underlines their ecological importance in spontaneous succession and regeneration of disturbed and contaminated areas.

Performance of specialists and generalists across ecological and evolutionary scales

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Background and aim: Current conservation biology suggests that in most regions, the species in most decline today are ecological specialists, i.e. species that occur across a narrow range of environments. Conversely, the speciation literature suggests that on an evolutionary time-scale specialists leave as many or more descendant lineages as generalists, i.e. they have high rates of global diversification. This begs the question: which of these two processes has more influence on the regional scale, i.e. do specialists leave more or fewer descendants than generalists within a region? In this presentation we give a few examples of the performance of specialists and generalists.

Methods: For the Netherlands we now have species-level information on species co-occurrences in small plots, habitat requirements, phylogeny, life-history traits and long-term trends. Using the Dutch Vegetation Database, we quantified niche volumes of Dutch plant species and used sister taxon comparisons to compare specialist and generalist sister taxa for the relative numbers of descendants across two temporal scales: ecological and macroevolutionary.

Results: We show, first, that specialist species are more likely to be currently declining, i.e. to leave only few descendant populations. Second, most specialist clades left fewer descendant species within a region than their generalist sister clades. These results held after accounting for species life histories. Differences between specialist and generalist sister clades increased with clade age, suggesting that they reflect differences in rates at which specialists left descendants (rather than differences in ecological limits to the numbers of specialists and generalists).

Conclusion: We conclude that specialists left only few descendants within a region (i.e. the Netherlands), both at ecological and macroevolutionary scales. While specialists may leave numerous evolutionary descendants at a global scale, these might be absent from most regions. Humans, by threatening specialist species, may hence further accelerate biotic homogenization with descendants of generalist lineages proliferating within regions while specialist lineages disappear.

Poster A56

Species and communities diversity of alvar forests in NW Estonia

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The alvar forests represent a rather exotic type of vegetation presented only in some areas around the Baltic Sea. Our study was carried out in 56 respective communities growing on habitats where limestone, gravel, grit or shingle layer is close to surface, with thickness of soil up to 30 centimetres. The soils are rich in carbonates but in summer period they often will be very dry. These forests are of low productivity and have a peculiar xeromesophilous ground vegetation including numerous xerophytes, clacifilous meadow and steppe species, as well as species of sub-nemoral forests. The species diversity is remarkably high, deriving first of all from the number of field and moss layer species. The field layer species diversity is usually higher in pine forests where tree crowns do not shadow the surface so much as in stands dominated by spruce or deciduous trees. The number of species in all layers, except moss layer, depends significantly from the factor 'Type group of communities' reflecting in integrated form effect of communities structure. Diversity of field layer species is negatively affected additionally by the ratio of carbon and nitrogen content in soil humus horizon, and species number of moss layer by abundance of *Pinus* trees.

The analysed sample comprises four types of alvar forest communities: (i) *Inula salicina–Potentilla fruticosa–Pinus sylvestris*, (ii) *Carex panicea–C. cespitosa–Pinus sylvestris–Betula pubescens*, (iii) *Filipendula vulgaris–Brachypodium pinnatum–Pinus sylvestris* and, (iv) *Brachypodium pinnatum–Calamagrostis arundinacea–Picea abies–Pinus sylvestris*. The 2nd community type represents the Sesleria alvar forest site type (FST) habitats, while communities of the 1st, 3rd and 4th types belong to the *Calamagrostis* alvar FST. These communities grow mainly on medium thick or thin Calcaric Skeletic Regosols, less frequently on thin Renzic Leptosols or on other types of soil. The established community types have syntaxonomical continuum towards boreo-nemoral *Hepatica* ands/or *Aegopodium* FST communities. A strong positive correlation between the soil humus horizon specific surface area and pHKCl with deciduous trees basal area and height of the 1st sublayer of trees was established, between the humus horizon $CaCO_3$ content and spruce basal area a negative correlation exists.

Poster B74

Do forest-dwelling plant species disperse along landscape corridors?

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There seems to exist an agreement that woody corridors can act as alternative habitats for forest dwelling plant species, but the great variation in the origin of corridors and species-specific responses blurs the overall assessment. The aim of this study is to evaluate the suitability of corridor habitat for forest plants by estimating plant dispersal patterns from a stand into and along an attached woody corridor, and explain the observed pattern with functional traits of plants and corridor structural characteristics. We sampled 47 forest-corridor transects from a boreonemoral vegetation zone in the agricultural landscapes of southern Estonia. Regionally common forest-dwelling species (observed in at least 10% of seed-source forests) were classified on the basis of their ecological response profile – forest-restricted species (F-type) and forest-dwelling generalists (G-type).

The species richness in corridors decreased sharply from forest into the corridor within the first 5-10 m. The corridor structural characteristics associated with the species richness were corridor width, historic age, canopy closure of trees or shrubs and the presence of a ditch. The species richness of F-type species was higher in old (≥50 years) and wide (≥10 m) corridors, whereas the richness of G-type species was promoted by young (<50 years) and narrow (<10 m) corridors with soil disturbances. Corridors with semi-open canopy supported both response types. Functional traits also revealed a significant relationship for the species dispersal patterns.

Our survey results imply that woody corridor type landscape elements are not the first priority alternative habitats for forest dwelling plant species, particularly in intensively used agricultural landscapes. Even if the dispersal pressure out of forest is high, young age and densely closed structure of corridors dictate low habitat quality and suppress forest species establishment.

Raised bog studies, monitoring and management

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The importance of raised bog conservation is determined by the fact that half of Latvian mires covering 4.9% are influenced by human activities, like drainage and peat extraction. At the same time, especially protected areas include vegetation of high conservation value, such as, intact raised bogs with the labyrinths of bog pools, old growth forests and lakes where restoration management is needed. The aim of the study is to follow the vegetation and site hydrology change after rising of water level in raised bogs and evaluate management effectiveness.

From 2003-2013 raised bog studies are carried out in 7 especially protected nature areas in the Western and Eastern Latvia. They include vegetation and site hydrology studies. In 2003 the first studies were carried out in Cena Mire, where a total 114 of relevès were made to characterise vegetation and 130 permanent plots were established next to hydrological monitoring areas. Similarly, habitat and hydrological studies are carried out in other sites, like Melnais Lake Mire.

In 2006 raised bog habitat restoration was carried out in Cena Mire. One year after rising of groundwater level, changes in the mire vegetation were observed, which in the next years to follows became more obvious. The coverage of *Eriophorum vaginatum* increased while die back of *Calluna vulgaris* is observed, as well as ditches are colonised by *Sphagnum cuspidatum*. In another site – Vasenieki Mire in the ditches *Utricularia minor* and *Warnstorfia exannulata* appeared.

Similarly, vegetation changes are observed also in Melnais Lake Mire where in winter 2012 the raised bog restoration by building dams on the drainage ditches was carried out within the EC LIFE+ Project „Restoration of Raised bog habitats in the Especially protected nature areas of Latvia". Six month after building of dams the coverage of *Eriophorum vaginatum*, *Rhynchospora alba*, *Sphagnum angustifolium*, *S. cuspidatum* and *S. rubellum* had increased. Development of *Sphagnum* mats was observed in ditches thus diminishing the water outflow from raised bog. The largest impact of rising water level by in the raised bog is observed in 1-2 m zone along ditches where most significant vegetation changes occur. However, changes are observed even at a 100 m distance from ditch. The habitat monitoring results show that in the next vegetation period after raising of water level, clear vegetation changes are observed which testify about the positive effect of the raise of groundwater level.

Impact of environmental gradients on community assembly

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Assessing functional diversity through understanding of trait diversity can provide insights into the factors driving community assembly and how they vary along gradients. Here we assess how the impact of the environment on convergence/divergence may differ between life-stages (vegetation v. seedbank) or taxa (plants v. beetles). The data show higher habitat filtering on the vegetation than the seedbank, and that there are clear correlations in functional diversity between the plant and the carabid assemblage.

The paradox of the crosstimbers

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The crosstimbers represent an enigmatic vegetation type, dominated by *Quercus stellata* and *Quercus marilandica*, and covering much of Oklahoma and Texas, USA. While in much of North America, *Quercus* forests are considered successional, various lines of evidence point towards long-term persistence of crosstimbers in Oklahoma. Other lines of evidence hint at substantial changes in the 20th and 21st centuries. Our understanding of crosstimbers dynamics is hampered by the lack of long-term data from mapped stands. We established a 4ha plot in 1998 in a crosstimbers stand in north central Oklahoma, and resampled it in 2008. We also cored and aged a sample of 55 trees. Q. stellata dominated, but decreased in density from 1701 stems ha^{-1} to 1359 ha^{-1} while its basal area increased from 18.0 to 20.6 m^2 ha^{-1}. Q. marilandica had much higher mortality, experiencing a drop in density from 213 to 126 ha^{-1} and a loss in basal area from 2.3 to 1.7 m^2 ha^{-1}. Recruitment of both *Quercus* species and the number of stems of other species were negligible. Both *Quercus* species experienced high (>60%) mortality in the smallest size classes, while Q. *marilandica* also had high mortality in the largest size classes. Diameter distributions are unimodal for the stand as a whole, and the mode is shifting towards the right. Mortality and growth are both density dependent (at neighborhood sizes <5m), implying thinning due to competition. All of these observations are consistent with a stand undergoing succession. However, other observations do not fit comfortably within a successional context: there are no obvious species to replace the two *Quercus* species, the mode of the diameter distribution does not represent a single cohort, and historical aerial photographs do not clearly indicate changes in forest structure consistent with a maturing stand. We speculate that multiple factors are responsible for the paradoxical nature of dynamics in this stand, including a prolonged period of forest exploitation, frequent ground fires, and a regional but still unexplained phenomenon of dieback of Q. *marilandica*. We predict that under current management, the forest will eventually resemble a Q. *stellata* savanna, although there is no clear evidence that such savannas have ever been part of the regional landscape.

Poster A57

Effects of nitrogen deposition and soil phosphorus content on species incidence in acid grasslands – congruence between spatial and temporal patterns

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Nitrogen, although essential for life on earth, is forecasted to be among the three major drivers of change in biodiversity worldwide. Transformations of the soil chemistry (e.g. soil acidification), an altered plant community composition due to changing competitive relationships and an increased sensitivity of individuals to stressors are just some of the nitrogen deposition impacts. A second nutrient known to have a strong effect on biodiversity is phosphorus (P), the availability of which has also increased in many terrestrial and especially aquatic ecosystems.

In this study, we worked with two datasets from semi-natural acidic Nardus grasslands. The first dataset encompasses 153 plots sampled in 2007 along a spatial gradient of 10 countries within the Atlantic biogeographic region of Europe, with nitrogen deposition levels ranging from 2.4 to 43.5 kg N ha^{-1}yr^{-1}, combined with measurements of soil variables. The second dataset covers a temporal gradient from 1940 to 2007 with species occurrence data from Germany and the Netherlands. Our main objective was to bring the two datasets together and examine whether the spatial and temporal patterns of responses of species to N deposition, topsoil pH and available P coincided, and whether differences or changes in species incidences were driven more by N deposition or P availability. In addition, we aimed to examine in how far the responses of species were correlated with specific life-history traits. Data was analysed using generalized linear mixed models, extracting the ß-coefficients (= slopes) of the species in the regressions on, on the one hand, N deposition, pH and P, and, on the other hand, the year of sampling.

Among 44 species analysed in the spatial dataset, 25 responded significantly to pH (19 positive, 6 negative), while 13 were significantly affected by N deposition (4 positive, 11 negative) and P (6 positive, 4 negative). The ß-coefficients for N deposition were positively correlated with the ß-coefficients for year on both countries in the historical dataset, indicating congruence between spatial and temporal patterns. The same positive correlations were obtained for P, while the ß-coefficients for pH were uncorrelated with those for year.

The results suggest a co-determination of P and N for the occurrence of acidic grassland species. Species with a positive response to N deposition and P (and usually having a positive temporal trend) tended to have a relatively large minimum height, a high relative growth rate and high seed mass.

Poster D140

A regional bioclimatic model of forest stands for Central Siberia

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A regional bioclimatic model of forest stands (SibFor Stand) is developed for Central Siberia that models a stand dominant tree species and ground layer's dominants from site climatic indices and a forest type group is recognized as their combination (intersection). This model is static and statistical. A database of Central Siberia inventory units, data from literature (Usoltsev, 2010) and our field data were used to develop our model.

During the working, the following results were obtained:

- climatic ranges of distribution and optimal of major forest-forming species of Central Siberia: *Pinus sylvestris, Larix spp., Pinus sibirica, Abies sibirica*;

- climatic ranges of background plain forest type series, reflecting both zonal hydrothermic soil conditions and indicating stand productivity;

- forest type groups that are a product of a logical conjunction between composition and productivity of a dominant tree species and a dominant of ground layer;

- relationships of stand productivity reflected as a mean height of the first forest layer and a site quality class from climatic factors;

- structure changes in forest cover of Central Siberia under climate change predicted from three SRES scenarios (A2, A1B и B1) and the Had CM3 GCM at 2020, 2050 and 2080.

The algorithm is realized in a set of macros in the GIS environment of the program Idrisi Andes.

As a result a set of electronic maps of the potential distribution of

- major forest-forming tree species;

- mean heights of the first stand layer;

- forest type series and forest type groups

was obtained across Central Siberia in current climate and for 2020, 2050 and 2080 from the climate change scenarios of the leading world climate centers (www.ipcc-data.org):

Community ecology of absent species

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Community ecologists have so far focused mainly on species identified at a site. I suggest that we can understand better patterns and their underlying processes in ecological communities if we explore those species absent from the community. First, traditional sampling might be insufficient to detect dormant or rare species. Fortunately, modern DNA-based techniques can help us to find "hidden" species. Second, most species do not actually belong to the species pool of the community: their ecological habitat requirements differ or their distribution area is elsewhere. Such species are usually not relevant to a particular community but might form novel ecosystems. Third, a large part of the habitat-specific species pool is likely absent and constitutes dark diversity. If we know both observed and dark diversity, we can estimate community completeness and infer those processes that "divide" species into observed and dark diversity.

Scale and context dependence of plant species richness in forests and woodlands of southeastern North America

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Plant species richness has been variously shown to be high where propagule supply is high, competition is low, disturbance is intermediate, or soils are of intermediate or high fertility. Part of the challenge in finding consistent patterns is that the critical processes vary with ecological context as well as spatial scale. We examined how the most important factors vary with ecological context and scale of observation for four sets of forest and woodland vegetation in southeastern North America: the uplands of the Blue Ridge Mountains, the Piedmont, the Coastal Plain, and the riparian forests spanning these regions. One factor driving variation in species richness is propagule movement or mass effect. In regions of rapid environmental turnover or efficient propagule movement richness is high, which partially explains the higher richness in forest of the Blue Ridge as compared to the Piedmont. The highest large-scale richness was seen in the riparian forests of the Blue Ridge where topographic complexity and propagule movement by water both enhance species influx rates. A second important factor is soil fertility as measured by cation availability. Although species richness increased with soil cation availability at large scales for all four of data sets, highest richness at small scales occurred in open Coastal Plain woodlands characterized by low cation availability. The shift in the peak of richness along the cation gradient from grasslands to forests can be explained in terms of a shift from symmetric to asymmetric competition. With increasing cover of woody plants, light penetrating to the herbaceous layer declines, which allows richness to keep increasing with fertility until the lushness of the herbaceous layer causes competition for light within the herbaceous layer to be important. Thus, one can envision a sequence from grassland to open woodland to closed forest with the peak in richness moving progressively toward more fertile conditions. Numerous previous studies have examined species richness, but typically in the context of a single spatial scale, and for a single region, vegetation type, or environmental gradient. Different community assembly processes operate at different spatial scales, with biotic interactions and local environmental filtering dominant at smaller scales, and dispersal and dominant at larger scales. By looking at richness across a broad range of regions, community types and spatial scales, we show that to understand patterns in richness, a holistic approach must be taken that examines all of these components concurrently.

Poster E183

Impact of past management practices on tree growth

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For centuries, large part of European forests was managed by coppicing. Stems re-sprouting from coppice stools were harvested regularly in a maximum of 40 year coppice cycle to obtain firewood. Coppicing with standards was often practiced, which means that selected trees (standards) scattered among coppice stools were left to grow for several coppice cycles to obtain larger wood for construction etc. In coppice system, forest conditions were changing markedly following the coppice cycle, shaping the growth dynamics of standard trees. After the underwood harvest, the forest opened rapidly, giving the standards the opportunity to benefit from improved light conditions. This primary stage was followed by the canopy enclosure as the coppice stools re-sprouted. Such form of management having large influence on forest functions was common in forests for centuries, but it was mostly abandoned after WW II. Most of the coppice forests were transformed to high forests or left to overgrow. Nowadays only remnants of such old management practices are found, but still such historical cyclic management practices can be traced in tree rings of remaining standard trees.

In our study we assess the influence of management (coppicing) on oak standards and tree growth by dendrochronological analysis. Oak-hornbeam forests on nutrient rich calcareous soils and acidophilous oak forests growing on nutrient poor soils, both in Český Kras Protected Landscape Area, Czech Republic, are investigated. We compare the growth increase involved by coppicing using tree-rings to the historical coppicing events recorded in historical forest archives. We also examine the cored standards neighborhood to analyze the influence of the competition of surrounding trees and coppice stools on the standard tree increment and on the response of trees to the coppicing events.

Diversity and drought tolerance of native *Calicotome villosa* rhizobia isolated from native populations

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Successful land restoration by the re-introduction of native vegetation is of major relevance in many parts of the world. The use of legumes and their nitrogen fixing simbions in such endeavor has been taken into account due to the benefits of legumes in agriculture. However, effective use of soil microbes in re-vegetation requires knowledge of how microbe communities behave in stressful environments and how efficient is the interaction legume-rhizobium under such conditions. In Spain, shrubby legumes dominate many ecosystems where drought, varying pH, and at a lower level salinity, are major issues.

The present work investigates the diversity of rhizobia associated with the shrubby legume *Calicotome villosa* in Spain. Rhizobial strains were isolated from root nodules collected in two populations from the Natural Park Los Alcornocales. Population varied in altitude and the average annual rainfall, being both in a semi-arid area. The in vitro tolerances of rhizobial strains to NaCl, pH and high temperature in pure culture varied greatly regardless of their provenance but were not correlated with the corresponding edapho-climatic characteristics of the sampling sites. Based on 16S rRNA gene sequence comparisons, the 15 new strains isolated were ranked into 3 phylogenetic groups representing three bacterial genera, namely, *Mesorhizobium, Rhizobium* and *Bradyrhizobium. Calicotome villosa* from the driest population, appeared as the most promiscuous host as it was efficiently nodulated with the widest diversity of rhizobia taxa including both fast-growing ones, *Rhizobium* and *Mesorhizobium*, and slow-growing Bradyrhizobium. Little difference in efficiency was found between bacterial taxa isolated from this species. The tolerances of strains to drought, salinity and temperature is currently being tested in symbiosis with their host plants to select the most adapted C.villosa-rhizobacteria taxa associations for further re-vegetation and land reclamation programs.

Poster A11

How to be a germinating seed in a harsh environment. The case of native provenances and even-aged plantations of *Cedrus atlantica* (Endl.)

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Atlas cedar *Cedrus atlantica* is a relic conifer relatively indifferent to soil nature. However, regeneration from seed in natural stands seems to be difficult and it is practically absent in even-aged plantations. We aim to determine whether there are contrasting patterns of seed and germination characteristics in Atlas cedar, comparing seed from natural stands with those from even-aged forestations. We hypothesize that these characteristics explain its restricted geographical distributions and the absence of regeneration man-made plantations outside its natural range. We evaluated the germination characteristics of freshly collected seeds from different locations in Sierra Nevada (Spain) and in Talasemtanne Mountains (Morocco) –the species northern distribution limit-. All sampling stands were located between 1700-1800 m.a.s.l. The size and mass of the seeds, and the influence of light, drought, presence of nutrients and pH in the media on their germination, were measured. Experiments were performed in germination chambers under constant temperatures of 22 °C, with a 12-h photoperiod, as well as in continuous darkness. All seed studied had a mass varying from 0.7 to 2.25g. Seed from this species required a pre-stratification period of 18 days. No significant differences were observed for seed germinated in light or darkness. Drought treatments were promoted by means of the addition of increasing amounts of Polyethylene Glycol (PEG) to aqueous solutions. The increased in PEG concentration showed significant negative linear correlations. Similarly, there were significant positive correlation between germination and decreasing values of pH. Germination was also triggered by the presence of potassium nitrate in the media. The responses observed suggest that light-darkness treatments are not a requirement for germination for this species. However it seems very likely that the limiting factors for the species to recruit seedlings are the pH and the water availability in the media. The observed tolerance of these seeds to a wide range of nutrients in the media is consistent with the wide tolerance to soil chemistry observed in the natural Atlas cedar range. In addition to that, we have observed a delayed germination in batches of seeds, suggesting that the species produces seeds with different degree of dormancy as a response to the toughness of the environment were they have to germinate. After all, these seed characteristics cannot by themselves explain the low level of seedling presence in the field and the restricted distribution of this species.

Poster D150

Modelling germination of native vesrsus invasive species using the Richard's function

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Seed germination is a complex biological process. Specialized literature records many attempts to express this process in mathematical terms. Traditional analysis of germination percentages gives low information, whereas techniques such as curve fitting provide better information from both points of view the biological and the mathematical. Frequently used parameters of germination such as rate and final germination percentage can be combined in single indexes which not always reflect important biological features like the length of the experiment or the peaks of germination. The so called Richard's function has been suggested to be a more universal method to evaluate germination and to compare it in a more comprehensive way than mere final percentages of germination. Although the functions proved to be of value in annual species, little is known on its importance when describing germination behaviour for other life-forms. This work presents results of germination of seed of fifteen species in five life-forms, including annual herbs, perennial herbs, small and medium-size shrubs. We took into account if species were native to the Iberian Peninsula or if they are considered as crop weeds. Finally, we analysed seed characteristics, including the presence of a hard coat and/or appendages. Seeds were treated with three levels of charred wood and smoke and with three nutritious compounds applied at three concentrations and adjusted at five values of pH. Data were fitted to sigmoid models, including Richards function. Results indicate clear differences in germination behaviour derived from the considered life-form and also depending on weather the species is a week or a native one. In those seeds with a hard coat, rate and level of germination are enhanced by the application of heat treatments. No consistency was observed in both, level and rate of germination after smoke exposure related to life-forms, neither for the survival data. The procedure of curve fitting applied achieve good agreement between observed and expected values estimated from the Richards function. It can be applied in the understanding of complex values of germination and seedling survival that can not be treated with other mathematical models.

Poster A12

Wild ungulates shape plant distributions in fragmented landscape: an experimental approach to endozoochorous dispersal

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Dispersal is a key process which sustains intraspecific diversity within populations and allows species to track changes in the spatial distribution of their resources. It becomes even more critical either when metapopulation connectivity is altered by landscape fragmentation or global warming. Seed dispersal is mostly passive and may involve interactions with animal vectors, including seed consumption by herbivores (endozoochory). This process is suspected to be critical in plant responses to global changes, but its significance remains to be experimentally assessed.

We aim at evaluating the contribution of endozoochory to plant distributions and the resulting patterns of community assembly. Our objective is to calibrate, using experimental data, a mechanistic model for plant dispersal in fragmented landscapes, accounting for plant and associated animal vectors' habitat preferences. We describe the intended model structure, experimental calibration and several preliminary results. We build our approach on three wild ungulate species with contrasting digestion strategies and body mass: red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*) and wild boar (*Sus scrofa*), which have large home ranges, and the potential to cover long distances across diverse habitats.

We first aim to identify the composition of dispersed plant assemblages from ungulates' faeces collected in two forest of the centre of France, and to explore the taxonomic and functional diversity of seedlings that germinate from these samples. From preliminary results, small seeded plants should exhibit the highest germination success because they pay a relatively low tribute to animal digestion.

Second, we will estimate seed dispersal distances by coupling seed retention time (from feeding experiments) and distances covered by the vector (from GPS monitoring). All seeds are retained longer by non-ruminant than ruminant species, and small seeds are released earlier than large ones. Seeds with long retention time are dispersed further, but may in turn experience lower germination probabilities due to long exposure to digestive enzymes.

The last step will be to estimate seed viability after release, to assess the cost associated with endozoochory. We expect to exploit these experimental data to calibrate a synthetic model of plant dispersal. The primary aim of this model will be to describe plant distributions patterns that result from ungulate-mediated seed dispersal. We specifically intend to evaluate how dispersal contributes to metapopulation connectivity within various habitat fragmentation levels.

What are we missing by relying only on community weighted means and alpha functional diversity in trait-based community analysis?

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Background: Vegetation ecologists often use community weighted means (CWM) and alpha functional diversity (FD) to summarize trait patterns across environmental gradients. Nevertheless, community species composition that is fuzzy-weighted by species trait similarities may often contain additional information that cannot be expressed by CWM and alpha FD. What are we missing?

Aims: Here we introduce the concept and the measurement of beta divergence and its links to environmental variation.

Method: We use as input matrices: B of species by traits, W of species proportions in communities, and E of one or more ecosystem factors or effects in the community sites. CWMs are computed by matrix multiplication T = B'W. Vector R of FD is defined by Rao entropy. Further, species composition is fuzzy-weighted by the species' pairwise trait similarities, generating matrix X of species by communities, hereafter called fuzzy-weighted community composition (FWCC). Each element in X is the probability of finding a given species considering the similarities of this species to the ones occurring in the community. We assess by Procrustes rotation the congruence r(TE) between CWM and E, and r(XE) between FWCC and E. Further, we define partial Procrustes congruence r(XE.T) and r(XE.TR) by using the residuals of linear models adjusted for response matrices X and E using as predictors, respectively, T and combined T and R. The significance of these congruence values is tested against a null model involving permutation of the species in B and re-computation of T, R and X, while maintaining W and E constant.

Conclusion: Analysis using simulated data revealed expected patterns. Since FWCC retains more trait information at the community level than CWM does, r(XE) is an omnibus expression of the linking between the factors or effects in E and alpha and beta trait diversity at the metacommunity level. r(TE) indicates the tendency of communities and species being more similar under similar environmental conditions, thus expressing trait convergence. Congruence r(XE.T) conveys the linking between E and the component of FWCC that is not explained by CWM, thus by inference reflects trait divergence for both beta and alpha diversity. By also removing alpha diversity, r(XE.TR) expresses the fraction of FWCC that is not explained by both CWM and alpha FD, which we define as beta divergence related to E. Further results with real data will be discussed.

Use it but don't misuse it: Evidence-based practices for restoration of Mediterranean temporary ponds

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Background: Mediterranean temporary ponds (MTP) are seasonal wetland habitats that due to their uniqueness and nature value are classified as priority habitat (3170*) for conservation by the Habitats Directive. Historically, MTP plant communities' conservation was compatible with traditional extensive land use. However, in the last two decades, modern industrial agriculture and tourism, among other threats, are causing a steep decline in this habitat. In this context, it is important and urgent to act in order to preserve and enhance the remaining temporary ponds, even if they are disturbed.

Objectives: For Mediterranean temporary ponds management and conservation we aimed to answer the following questions: Is temporary pond set-aside a useful management practice for pond recovery? Can we recover a temporary pond with simple and low-cost techniques?

Methods: Changes in plant species cover in fenced Mediterranean temporary ponds, in the Southwest region of Portugal, was monitored for five year in order to access exclosure effects. A pond restoration field experiment was undertaken by: levelling pond depression topography; by facilitating pond plant species establishment with soil seed bank inoculum; and by promoting soil compaction using cattle trampling. Plant species composition and percent cover were visually estimated for all species. Hydroperiod monitoring was done by collecting data on water depth in pond center.
Results: In the exclosure experiment we observed a change in the relative proportions of plant species physiognomic types. Namely, in the last years the pond area began to be colonized by phanerophytes. Restoration actions enabled a fast recovery of plant species. The inundation period was successfully re-established.

Conclusions: We do not advice permanent fencing as a management action for Mediterranean temporary ponds. Our results suggest that moderate grazing is important to Mediterranean temporary pond conservation. This land use promotes the soil compaction and avoid that terrestrial plant species occupy pond area. Restoration of pond topography, soil conditions and hydrological regime are determining factors for temporary pond restoration projects success and for its persistence.

Poster E163

Dry calcareous grasslands from two neighboring biogeographic regions: relationship between plant traits and rarity

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Semi-dry Central European and NW Balkan (Dinaric) dry calcareous grasslands represent physiognomically similar plant communities, that occur in similar environments (e.g., soil type, altitude and precipitation rate) and are subject to similar low-extensive management. Those grasslands, although ecologically parallel, are not equally rare and threatened: NW Balkan dry grasslands are still common and currently not yet endangered as the Central European ones certainly are. We investigate, to what extend grasslands from both regions, differing in rareness and threats also differ in their floristic and functional composition. We compare traits of red-listed (threatened) and non red-listed plants, related to species resource use strategy and ability to compete for light and test the effect of community-weighted means (CWM) on threatened species richness. The results showed that the regions differed significantly in floristic composition, which was expected. We found greater species diversity in the Balkan grasslands, which may be explained by the biogeographic history of the region. Differences in functional composition between plant communities from both regions may reflect stronger effect of eutrophication and local disturbance of the Slovenian Central European dry grasslands. The red-listed species occur with similar frequency in both regions, which suggests that in both regions the processes leading to rarity in these grassland species are comparable. However, some of the non red-listed species could become threatened in future due to abandonment in both adjacent biogeographic regions. This study may represent important implications for conservation management of these grasslands.

Where does the community start, and where does it end: including dormant communities changes the outcome of community analyses

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The storage effect is a pivotal mechanism in upholding species coexistence and diversity in resource pulse environments, where resources access fluctuates in time and space. In temperate forest, communities are constrained by unpredictable access to light in space and time. Theoretically, the herb layer and seed bank stably coexist by means of the storage effect, when evaluated at large enough temporal or spatial scales. However, both communities are never considered together, despite the fact that distinct hierachy in the response of communities has already been observed in resource pulse environments. Most likely, this is because seed bank and vegetation often display similar responses to environmental variation, but is this really the case?

We inventoried vegetation, seed bank and environment in 138 plots in temperate deciduous forests in seven regions across NW-Europe. We investigated whether vegetation and seed bank community structure responded similarly to environmental variation and whether the seed bank + herb layer community respond differently than its individual component communities. Additionally, we asked where most forest understorey diversity was present: in the seed bank or herb layer?

First, we noted that most forest understorey diversity is stored in the seed bank, with diversity partitioning between the herb layer and seed bank being dependent on environmental drivers such as canopy cover and time since disturbance. Nonetheless, for each unique species in a mature forest stands' understorey, there is one unique species in the seed bank. Second, although seed bank and vegetation did often respond similarly to environmental variation, several community characteristics displayed a hierarchical response to these environmental drivers. Seed bank and herb layer diversity and community heterogeneity did not respond to forest continuity and canopy cover respectively, whereas seed bank + herb layer diversity and community heterogeneity increased with forest continuity and canopy cover respectively. Conversely, time since disturbance negatively affected seed bank and herb layer community heterogeneity, but not in the total community.

In conclusion, a large part of forest understorey diversity is stored in the seed bank. Nevertheless, at the right spatial and temporal scale, seed banks are a functional part of the forest ecosystem, and should therefore be integrated in community analyses of the forest understorey. The major argument being that when seed bank and herb layer are analysed in unison, parallel patterns in these individual communities change, marking a distinct hierachy in community responses to environmental variation.

Temperature requirements of pollen germination control species' altitudinal distribution

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The major factor controlling altitudinal distribution of plant species is climate, with temperature being the most important component. However, an ecophysiological mechanism with high predictive efficiency in defining of species elevation ranges is still missing.

In the present study we tested the hypothesis that altitudinal distribution of plants is controlled by specific temperature requirements of the progamic phase (pollen germination and tube growth). In the experimental part of the study we identified cardinal temperatures of the pollen germination and the pollen tube growth for 26 plant species with different altitudinal distribution in Southern Bavaria (Germany). Statistical analysis showed that initial temperatures of both processes as well as optimal temperature for pollen tube growth rate are strongly negatively correlated to altitude (r^2 = 0.49, p<0.001; r^2 = 0.57, p<0.001 and r^2 = 0.57, p<0.001 respectively). We conclude that increasing negative temperature stress along altitudinal gradient limits upward distribution of species with high temperature requirements of the progamic phase.

Past anthropogenic land-cover changes and their effect on terrestrial carbon storage and climate in Europe

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In order to estimate the impact of past anthropogenic land-cover change (ALCC) on terrestrial carbon storage and climate in Europe, we have produced a new land-cover dataset combining the natural vegetation dynamics simulated by the dynamic vegetation model (DVM) LPJ-GUESS (Smith, 2001 GEB 10) and the anthropogenic land-use from two commonly used scenarios of ALCC KK10 (Kaplan et al., 2009 QSR 28) and HYDE3.1 (Klein Goldewijk, 2011 GEB 20). To evaluate the combined LPJ-GUESS and ALCC land-cover description, we have used the LANDCLIM pollen-based REVEALS reconstructions of vegetation abundance in NW Europe (Gaillard, 2010 Clim Past 6; Trondman, in progress). The largest discrepancies between the DVM results and the pollen-based reconstructions are caused by the fact that LPJ-GUESS is simulating the climate-driven potential natural vegetation, not accounting for human-induced land-cover changes and time-lags associated with vegetation migration. Therefore, the ALCC scenarios were used either as a description of the anthropogenic land-cover integrated to LPJ-GUESS or during post-processing of the LPJ-GUESS outputs. Of the two ALCC datasets, KK10 was shown to be closer to the pollen-based land-cover reconstructions compared with HYDE3.1 (LANDCLIM, Kaplan, in progress). Moreover, post-processing using the migration models of Norway spruce (Picea abies) and European beech (Fagus sylvatica) developed by ECOCHANGE (http://www.ecochange-project.eu/) produced the Holocene dynamics of European forest composition similar to that suggested by REVEALS. To simulate the dynamics of terrestrial carbon storage and to estimate the anthropogenic carbon release to the atmosphere, we used LPJ-GUESS with and without integrated ALCC scenarios forced by climate derived from a transient simulation (7000 BC to AD 2000) with an Earth system model (Mikolajewicz, 2007 Clim Dyn 28). Our results imply that previous attempts at quantifying ALCC and its effect on the carbon cycle may have been greatly underestimated (LUCCI project, Olofsson et al., in progress). To evaluate the biogeophysical effects of ALCC on climate during two time-slices (4000 BC and AD 1800), we used LPJ-GUESS forced by climate reconstructions downscaled by the regional climate model RCA3 (Samuelsson, 2011 Tellus A). Alternative RCA3 simulations compared the effect of accounting for past land-cover based on ALCC reconstruction on the downscaled climate. Past ALCC (KK10 in particular) were found to have a significant impact on the RCA3 climate simulations, the differences depending mainly on changes in albedo and heat fluxes (LANDCLIM project, Strandberg, in progress).

Micro-environmental filtering drives functional convergence in species-rich grasslands

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The functional assembly of plants into communities is a key research area in ecology, enabling the inference of dominant processes through patterns. For instance, functional trait convergence and divergence is used to infer the relative importance of abiotic and biotic processes governing community assembly. It is expected that abiotic filtering producing convergence will occur at larger spatial scales – reducing the trait range of species from the regional species pool to the local community. Whereas, trait divergence generated by competition is expected to occur at smaller scales (where plants interact), if biotic filtering is important. We examined this in 33 dry calcareous grasslands on the islands of Saaremaa and Muhu in Estonia. In each site, we sampled along a transect (10 $\times$ 0.1 m), which was divided into 100 quadrats (10 $\times$ 10 cm). In each quadrat, we recorded species richness and composition, and measured various environmental variables (soil depth, moisture, temperature, and light availability). In each site, we collected trait data for the most abundant species in the transect; traits measured were plant height, specific leaf area, leaf size, leaf dry matter content, biomass and height:biomass ratio. We calculated functional diversity and mean trait values at several scales - the actual grassland community species pool, the transect, and the quadrat. This enabled us to compare filtering from the grassland functional trait pool – to the transect, and from the transect – to the quadrat. We found evidence for environmental filtering of traits from the grassland site to the transect with convergence of most traits, along with a reduction in mean height and leaf area. We also found functional convergence for most traits at the quadrat scale compared to functional diversity at the transect scale. There was also a tendency for traits in the quadrat to be smaller than the transect, with reduced mean trait values for leaf area, specific leaf area, biomass, and height. This suggests that even at very small-spatial scales co-occurring species are more similar than expected by chance, and environmental filtering was even stronger at small-scales than we detected from the site to the transect. We found environmental heterogeneity was linked to species and functional turnover along the transects, and hence, probably drives this trait pattern. We suggest that small-scale heterogeneity drives functional convergence in these grasslands through micro-environmental filtering.

Plant facilitation is mediated by soil microbial communities

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Positive interactions between plants are often attributed to buffering of abiotic extremes, increase in soil resources or protection from herbivory. However, soil microbial communities might play a role as well, modulating the outcome of plant interactions through mechanisms unexplored to date.

We tested the effect of soil communities on plant abundance and growth, functional traits, and reproductive output in an annual plant community and on individual species using soil extracts from the understory of a nurse plant species and from adjacent open spaces.

Soil bacterial communities under the nurse shrub, characterized by pyrosequencing, differed widele from communities in gaps, and had an outstanding positive effect on plant growth and performance. Both, individual plants and the whole community, favored the presence of different groups of microbes in the rizosphere.

Soil microbial communities modulated positive plant interactions through processes that are independent of direct effects of the benefactor species, influencing plant growth, reproductive output, and selecting for plants with certain functional traits. Plants modified soil microbial communities in ways that can lead to the establishment of positive feedbacks between soil and plant communities.

Plant invasions: the role of recipient habitats

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How much a plant community or habitat is invaded depends on a number of interacting factors and environmental settings, among which propagule pressure, climate and traits of invading species are traditionally considered most important. Recent studies have shown, however, that the identity of a habitat with its resource dynamics and disturbance regimes plays a key role in determining how much plant communities it harbours will be invaded. When assessing habitat invasions, distinction needs to be made between invasiveness as an inherent property of the habitat, and the actual level of invasion that we observe. Other issues that need to be taken into account are habitat species pools in both the source and target geographical regions as some habitat deliver disproportionally high or low numbers of successful invaders. Integrating these issues into a coherent framework would improve opportunities for risk assessment and for prediction of future invasions.

Poster A58

Local and regional patterns in composition of herb-rich forest vegetation in northern Finland

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Herb-rich forests are a rare and threatened forest type in Finland. Describing and understanding the local and regional patterns in species composition of herb-rich forests is essential for conservational aspects and for detecting the changes that will occur as climate and land use practices change. In this study, we quantified species composition and diversity of herb-rich forests plant communities in a latitudinal gradient from eastern central to northern Finland (62-68 deg.N). The cover of vascular plants and bryophytes were determined for 336 vegetation plots during the years 1968-76. Ordination analyses were run to investigate the local and regional patterns on community composition. Community level diversity parameters were compared among study areas.

Ordination analyses show that main trends of variation in herb-rich forests include a latitudinal south to north pattern. Both total species richness and richness in vascular plants declined towards north whereas in bryophytes no trend was found. More locally there are also patterns related to moisture level, pH and conductivity which are among key variables underlying compositional variation of herb-rich forests.

We conclude that herb-rich forest communities are regionally differentiated largely reflecting gross climate gradient. Species richness patterns also vary regionally being driven by regional climate, but also reflect local site conditions. Herb-rich forests are fragmented and sensitive to environmental changes. This study is a basis for an upcoming research in which plots used in this study will be resampled. Analyses will then be run to observe the changes occurring in local and regional patterns in species composition in a decadal time-scale.

Keywords: Species composition; Gradient analysis; Ordination; Regional variation

Poster E184

Effect of different cutting regimes on species diversity of rewetted fens

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Extensive peatland drainage in Central Europe and worldwide has resulted in high rates of peat decomposition, greenhouse gas emissions, surface and groundwater eutrophication, and habitat loss for endangered species. Nowadays farmers often abandon the cultivation of drained peatland because of raising costs and decreasing economic benefits. From an environmental, social, and economic point of view rewetting these areas is important to reverse the abovementioned negative impacts of drainage. Developing and implementing new forms of biomass use on rewetted peatlands as a renewable resource for e.g. bio fuels or insulation material would provide alternative income sources for farmers. At the same time this so called Paludiculture can help to preserve the remaining peat body with its environmental functions and therefore displays an alternative way of site adapted utilization.

In Western Pomerania many formerly drained fens have been rewetted without any management measures, i.e. allowing free succession. These sites are characterized by a mosaic of a few dominant rhizomatous helophytes (e.g. *Phragmites, Typha, Phalaris, Glyceria*). However, a few examples of long-term cutting with different mowing regimes exist (winter & summer mowing). In our study we investigated the effect of different cutting regimes on the vegetation and species diversity in rewetted fens to evaluate how annual cutting relates to nature conservation aims for fens.

Preliminary results show that rewetted fens without cutting show a higher species density and harbor more endangered species compared to managed sites. Our results are in contrast to the common expectation that regular mowing on meadows leads to an increase of plant diversity.

Trait profiles and biotic interactions as determinants of exotic plant performance

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Biological invasions are considered a key element of global change. Knowledge about plant invasions has increased in the last decades, but most studies focus on plant species that have already become invasive. Processes and drivers of the earlier stages comprising the establishment phase of introduced plants have received relatively less attention. Biotic interactions of introduced species with their natural enemies are receiving increasing attention, but again, most studies are focussing on well-established invasive plant species.

We studied the impact of aboveground herbivory and increased planting density on plants with different ecological profiles. We derived profiles from combinations of competitive (seed size) and defensive (toxicity) species traits as compared to traits of the other species in the experiment. We used eight Mediterranean annual plant species from two families that are present in Europe, but are not listed as invasive.

We established 96 microcosms with each containing four seedlings of one exotic species and an even mixture of Northern European seedlings. In a full factorial design, we exposed the exotic species to two levels of planting density (12 or 44 native neighbours) and the presence or absence of insect herbivores *Locusta migratoria* and *Mamestra brassicae*.

We found that both forms of biotic interactions negatively influenced shoot biomass with a stronger impact of planting density than herbivory. While planting density significantly decreased relative growth rate, herbivory had a significant negative impact on the ratio of average exotic shoot biomass compared to average native shoot biomass (biomass ratio). Treatments only marginally decreased seed production. Strong competitors clearly dominated the respective communities in terms of contribution to the total biomass. Defensive traits did not explain magnitude of leaf destruction by herbivores or response to herbivory.

From our study, we can draw the following conclusions: 1) Community density affected the internal (plant-based) value relative growth rate while herbivory affected the external (community-based) value of biomass ratio. Thus biotic pressures are important for explaining different aspects of performance of exotic species. 2) Competitive traits were good predictors of plant performance relative to surrounding species, also under increased community density. 3) Traits that determine interaction with herbivores were more context-sensitive than competitive traits. However, factors that influence exposure to herbivory are important to understand exotic species performance in a community context.

Outlining a matrix-based approach for safeguarding urban biodiversity

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Outlining a matrix-based approach for safeguarding urban biodiversity

In simple forms of fragmentation research, urban matrix has been considered non-habitat, even wasteland. During recent decades, research on matrix is increased and nowadays matrix really matters. However, understanding biodiversity through matrix is challenging both as a scientific endeavor and in conservation practice. In this paper we use a gridded data set of urban flora to explore the matrix properties of urban landscape in Tampere, SW Finland. As an indirect evidence of matrix qualities, we found three previously unknown hotspot areas in the city area based on species richness and rare species. Using these hotspots we develop a matrix-based approach to urban green governance by taking ambiguity as a starting point. Ambiguity is a key characteristic of urban complexity, and matrix which is in a state of constant change lies in the core of this dynamics. Hotspots are emergent properties of the matrix that entail both ecological and political ambiguities, and the idea is to make the ambiguities match in ways that support the identification of potentialities of urban biodiversity. We present the identification of hotspot areas as a first step of this new approach based on epistemic pluralism, human-induced enactment of biodiversity, and collaborative exploration of matrix.

Key words: matrix, grid, urban vegetation, biodiversity policy, collaborative conservation

Is restoration succeeding? Testing against the criteria of the SER primer

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Background:
Restoration is commonly undertaken in New Zealand, but here is little direct evidence that it succeeds in its supposed objective of facilitating natural succession towards a stable climax community.

Methods:
We investigate three forest restoration projects, using the criteria from the Primer of the Society for Ecological Restoration, to evaluate their restoration success. For each project we use 2-3 restoration planting stands of different ages, and reference these against some (relatively) undisturbed forest.

Results
The three projects are quite different floristically, but all show sequences which resemble successional patterns between the different aged stands. However planted stands still show very high exotic cover (especially exotic grasses), and presence of a strong shrub component. Stands may also show high species' diversity, presence of climbers, and a high diversity of seedlings of woody species, but are lacking in forest fern diversity and cover, especially of epiphytes and low native diversity.

Conclusions:
Restoration as a procedure is still only at early stages of development, and there is at best only a possibility that the normal successional processes will be eventually achieved. Longer-term monitoring is required, probably along with further in-planting, as well as more sophisticated research associated with designed restoration projects.

Diversity components of 14000-year palynological record: richness, evenness and phylogenetic diversity

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While palynological (based on sedimentary pollen data) richness and evenness have been relatively widely used to characterize the changes in past biodiversity, phylogenetic diversity which incorporates phylogenetic distances between the taxa, 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 and phylogenetic diversity. The mean pairwise phylogenetic distance (MPD) was used as the measure of phylogenetic diversity. 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. We then compared the development of different diversity components through time from Late Glacial period until the present day.

The maximum values of palynological richness were observed in the samples from last 500 years with 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 is most likely caused by humans creating additional habitats, introducing grazing animals thereby improving dispersal possibilities, and introducing new plant taxa. The increase in palynological richness is, however, accompanied by a decrease in phylogenetic diversity probably 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.

Long-term responses of a tropical palm community to hurricane disturbance

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It is generally assumed that palms (Arecaceae) have ability to withstand physical damage, particularly species growing in regions with a high frequency of hurricanes. I studied a palm community in the Bladen Nature Reserve (BNR), Belize, over a 14-yr period (1999-2012), which included the passage of category 4 hurricane Iris in October 2001. There are 14 palm species growing in the BNR. The first impression after the hurricane was that survival of all palm species was much better than survival of the majority of dicotyledonous trees. This seemed to also be the case for *Astrocaryum mexicanum*, the 1.5-6 m tall dominant understory palm and *Attalea cohune*, the 6-20 m tall dominant overstory palm. However, the long-term fates of these two species have been very different.

All mature *Astrocaryum* individuals survived the hurricane and they lost only 14% of leaves. Due to a substantial increase of canopy openness (from <7% to 32%), the mean fruit production increased from 45.4/tree/yr to 135.2/tree/yr during the first two years after the hurricane. In the following years the fruit production fluctuated dramatically and has stabilized at approximately 60% of the pre-hurricane level over the last four years. Preceding the hurricane mature *Astrocaryum* individuals had approximately the same mean density (433/ha on the average) as seedlings in the BNR, which indicates dramatic seedling mortality. However, the 2002-2003 cohort may contribute to the rather bizarre age structure of this species that is apparently caused by frequent hurricane events, associated with increased canopy openness, and increased seed production.

Mature *Attalea* individuals lost 40-90% of leaves, but initially it seemed that >90% of them survived. However, their seed production declined and about 40% of mature individuals died in 2 to 7 years after the hurricane. This observation solved one of the mysteries of this forest: while on average there are only 36 mature *Attalea* individuals/ha the density of saplings, which have never been observed to die, is an order of magnitude larger. With the average frequency of one hurricane every 18 years, the density of mature *Attalea* palms is kept relatively low while its saplings and all understory palm species are always profiting from periodic canopy openings. It seems that periodic hurricane disturbances are, at least partly, responsible for relatively high species richness of the BNR forests (91-107 tree species ≥5cm DBH/ha).

Macrophytes and microbes in tropical wetland ecosystems

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Macrophyte roots and rhizomes form close relationships with microorganism in wetland sediments. Different macrophyte species can affect the microbial community through unique root exudates and by provision of a litter of different quality. Microorganisms utilize organic carbon (C) compounds, release inorganic forms of nitrogen (N) and phosphorus (P) through mineralization, and provide additional N through N fixation. Coupling of C, N and P cycles and biogeochemical linkages driven by nutrient limitation in freshwater systems are understudied compared to other ecosystems like tropical forests and estuaries. Macrophyte primary production in wetland ecosystems is often limited by low supplies of N and/or P and is tightly linked to microbial functioning that contributes to nutrient supply. With increased nutrient inputs, plant – microbial interactions change, but our understanding of the change is still limited. We will provide examples of interconnectivity between C and P cycling and N fixation in freshwater marshes considering: (1) the effect of two macrophytes with different life strategies, a strong competitor, *Typha domingensis*, and a stress-tolerator, *Eleocharis cellulosa*, and (2) the effect of two trophic states, P poor, and P enriched. Under these different scenarios, changes in C sources from macrophyte litter as well as root exudates and their biodegradability show that the effect of plant species is generally higher than the effect of P enrichment. On the other hand, non-symbiotic N fixation that provides substantial inputs of "new" N into these wetland systems proves to be impacted more by P addition than by macrophyte species, although both effects are significant. Understanding how plant – microbial interactions shape ecosystem responses to elevated inputs of nutrients is important because nutrient inputs have been implicated worldwide in massive changes in biological diversity and ecosystem services.

Poster A59

Floristic and ecological patterns in Isoeto-Nanojuncetea communities on the Iberian Peninsula, Azores and Madeira

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To present a comprehensive revision of the class *Isoeto-Nanojuncetea* on the Iberian Peninsula, Madeira and Azores (c.a. 600000 km[2]), the indicator plant species for each community were identified and the classified plant communities were assigned to the EU-habitats Directive. Vegetation sampling was conducted in seasonal wetlands. Grassland communities were surveyed in homogenous quadrates and each taxon's absolute percent cover was recorded. Plant communities were classified with Hierarchical Cluster Analysis and subsequently a Similarity Analysis (ANOSIM) was used to test for significant differences in plant species composition. An indicator species analysis was used to find significant indicator for plant communities in temporary ponds. To test the consistency of indicator species analysis, diagnostic species were also determined by fidelity that was assessed by the coefficient *Phi*. Our data set was completed with relevés from Iberian Peninsula seasonal wetlands, stored in SIVIM (Iberian and Macaronesian Vegetation Information System) and BIOVEG (Vegetation-Plot database of the University of the Basque Country). In order to identify the ecological gradients behind the floristic patterns a CCA was applied to a selected subset of the data.

Plant communities of temporary or very shallow water are rich in species and in community types. Our work classifies them in putative associations and alliances within the *Isoeto-Nanojuncetea* class, using floristic similarity. The indicator/diagnostic species obtained by statistical analysis are compared with the character species of phytosociological associations already described. The indicator species approach represents a practical way of discriminating between different plant communities and habitat types. A unequivocal identification of habitat types is important for management and conservation measures. Almost all the communities are priority habitats according to the European Union Habitats Directive (no. 3120, 3130 and 3170*) for conservation.

Keywords: Classification; Diagnostic species; Ephemeral Wetlands, Plant communities; Syntaxonomy.

Poster A13

Dark diversity in calcareous semi-natural grasslands: are absent species dispersal limited?

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The abundance and composition of species in communities is affected by only four distinct processes: speciation, selection, drift and dispersal. Previous studies have found that many species represented in regional species pool are absent in local communities even though the ecological conditions for growth are suitable. Therefore, we can hypothesize that dispersal limitation is the main factor influencing the size of dark diversity (the absent part of the species pool). Dispersal limitation may arise from limited dispersal distance and/or a limited number of available propagules.

The main objective of this study was to assess whether those species absent from calcareous grasslands in the Baltic Sea Region are also species with limited dispersal ability. We analyzed a total of 1223 vegetation plots (1 × 1 m) in nine distinct regions in Sweden (Öland, Gotland, Götaland), Estonia (Saaremaa, Hiiumaa, north Estonia, west Estonia), and western Russia (Izhora, Izborsk). The regional flora (291 species) was designated as the total number of species identified in all vegetation plots from nine regions. Species co-occurrence index were used to distinguish absent species (dark diversity). We used specific plant traits (dispersal syndrome, life form, seed characteristics) to calculate maximal dispersal distance for each species. The average maximal dispersal distance and average seed weight were computed for the observed and dark diversity in each plot.

The absent species had significantly lower maximal dispersal distance and higher seed weight than the observed species. Since there is a trade-off between seed weight and seed abundance, it is evident that species in dark diversity produce few seeds. In conclusion, our study implies that species are absent from calcareous grasslands in the Baltic Sea Region owing to dispersal-based processes. Species with short dispersal distance and those that produce few seeds are likely forming the dark diversity.

Poster D141

Short-term changes in vegetation structure and dynamics after fire in Brazilian Cerrado

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Cerrado is one of the world's hotspots, being the richest savanna in the world in plant species. Since fire is one of the most important factors influencing this vegetation, it could be considered as a management tool in conservation units to maintain the structure, dynamics and diversity of Cerrado. Additionally, it could be a great solution to control wildfires that occur in these areas, destroying vast areas of natural vegetation. Thus, the aim of this study was to evaluate the short-term vegetation changes of "campo sujo," a Cerrado physiognomy characterized by a dominant herbaceous layer with scattered shrubs, subjected to fires during the dry season. The study was conducted at the Reserva Natural da Serra do Tombador, Goiás, Central Brazil. Four experimental plots were established and burned in July 2012. Vegetation surveys were carried out before (T0, dry season), three (T1, beginning of the rainy season) and six months (T2, rainy season) after fires in 10 subplots (1 X 1m) in each of the four plots. In each subplot, we sampled the number of species and estimated the cover of bare soil, dead biomass and species. Later, species were grouped into functional groups (graminoids, forbs and shrubs), together with soil cover and dead biomass. The cover of dead biomass before fires (T0) was 50.1±3.8%, decreasing to 7.5±2.9% (T1) and 9.5±2.5% (T2, p≤0.05). Bare soil cover showed an opposite tendency, increasing after fire experiments, due to the removal of aboveground biomass (T0=29.9±4.2, T1=87.0±2.9, and T2=63.0±2.8). After six months the average cover of graminoids, which initially covered 21.3±2,5%, reached the same cover as the one found at T0 (13.5±1.6%, p=0.1). The cover of shrubs also reached the same initial percentage six months after fire (T0=7.9±1.2%, T2=7.9±1.5%, p=0.1). Furthermore, the cover of forb species recovered very fast, showing already no significant differences three months after fire (T0=2.6±0.8% and T1=4.0±0.8%, p=0.1), and showing significant increases six months after experiments (T2=4.9±0.8%, p=0.02). Our results showed a rapid recover of all functional groups and the increase in forb cover six months after fire experiments. In short-term, forb species take advantage of the opening of new microsites within the vegetation and the removal of competitors to occupy space.

Is spectral diversity a proxy of plant species richness at a continental scale? A test on North American floras

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Entropy measured by the spatial variation of remotely sensed spectral signal may be a powerful proxy for species diversity at a number of spatial scales. The entropy of the Earth's surface is closely related to physical and ecological diversity. Since landscape diversity often relates to species biodiversity considering several ecological levels from species community diversity to genetic diversity, measuring entropy is an efficient and relatively cheap way of providing biodiversity estimates over large geographical areas. Depending on the study objectives, species diversity can also be modelled at appropriate scales in time and space. This is true in light of the Spectral Variation Hypothesis, which assumes that the higher the habitat heterogeneity, the higher will be the species diversity therein. Depending on the scale and the habitat being considered, the Spectral Variation Hypothesis can be expected to hold true in many cases.

Due to the difficulties of field-based data collection at wider spatial scales, the use of remote sensing for estimating environmental heterogeneity and (subsequently) species diversity represents a powerful tool since it allows for a synoptic view of an area with a high temporal resolution. For example, the availability of satellite-derived data with high spatial (IKONOS, Orbview-3, BGIS-2000 (Ball's Global Imaging System-2000), RapidEye) and spectral resolution (CHRIS (Compact High Resolution Imaging Spectrometer), Hyperion, GLI (Global Imager), MERIS (Medium Resolution Imaging Spectrometer), and MODIS (Moderate Resolution Imaging Spectrometer)) together with long lasting programmes like the Landsat program makes it feasible to study all terrestrial regions of the globe up to a resolution of few meters.

In this study we tested the spectral variation hypothesis based on the FloraS of North America Project (http://botany.okstate.edu/floras/) relying on species richness at different spatial grains. Latitudinal gradient and biogeography seemed to basically drive species richness patterns more than spectral heterogeneity at a continental scale. We conclude by offering advice as to the conditions in which spectral heterogeneity is likely to be a useful proxy for biotic diversity.

Poster D103

Dynamics of an endangered terrestrial orchid in response to experimental manipulations of fire and herbivory in a Texas post oak savanna

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Background & Methods- Fire and herbivory are widely recognised as important in savanna ecosystems, however, little is known about their effects on *Spiranthes parksii*, an endangered terrestrial orchid endemic to Texas post oak savannas. We designed a full-factorial, completely randomized field experiment to assess fire and vertebrate herbivory on *S.parksii*. Thirty-two 1.5 × 1.5m plots were established in areas of high orchid abundance. Treatments included i) burned and fenced, ii) burned, not fenced, iii) fenced, not burned, and iv) unburned, unfenced. Pre-treatment data were collected and 2-m tall fences with 10-cm wire mesh were erected in May 2009. Fires were conducted in July 2010 using a steel burn-box. We routinely collected data on orchids, herbaceous cover, light, and soil moisture in each plot through spring 2013. We then used these data to develop stage-structured population models to predict an asymptotic annual growth rate (λ) for each plot.

Results & Conclusions- There were no significant pre-treatment differences in rosettes or flowers. Surprisingly, there were fewer flowers in fenced plots than unfenced plots in 2009-10 (p=0.008) and 2010-11 (p=0.03). Both fenced and unfenced flowers experienced herbivory suggesting small herbivores may be more important than previously appreciated. Flower densities were markedly suppressed in all plots during 2011-12 likely due to unprecedented drought conditions and there were no significant effects of fences on flowering stalks in 2011-12 or 2012-13. Burning significantly reduced the number of flowering stalks in 2010-11 (p=0.01), but flowering stalk density was significantly higher in burned plots in 2012-13 (p=0.04). Rosette density was not significantly affected by fire or herbivory treatments during any growing season. Rosette leaf area was significantly greater in burned-only and burned-fenced plots than control and fenced-only plots (p=0.05) early in 2010-11, but the opposite pattern occurred in early 2011-12 (p=0.05). Rosette emergence occurred significantly earlier in burned plots than unburned plots in 2011-12 (p=0.03). Habitat loss is the leading threat to the persistence of *Spiranthes parksii*. An understanding of the ecology of the species with an emphasis on establishment, recruitment, and maintenance is essential for the conservation of this endangered species. Specifically, long-term assessments of *S.parksii* responses to fire and herbivory and using both experimentation and demographic modelling approaches will provide a more complete understanding of the implications of these disturbances for population dynamics. Additionally, studies examining precipitation variability, consumption by small herbivores, and soil community characterisations are necessary for developing a comprehensive habitat restoration strategy.

Poster C86

Effect of substrate contamination on pioneer vegetation structure

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The development of vegetation on heavy metal contaminated sites is extremely difficult due to the unfavourable physical and chemical properties of the substrate, as well as the limited pool of species capable of colonising them. Nevertheless, plants and cryptogams colonise such areas and often form distinctive communities. There are many publications on the vegetation of metal contaminated areas, but detailed studies concerning relations between vegetation and specific environmental variables are very scarce. The recognition of vegetation structure and particular species responses in the initial stage of succession is crucial for understanding the character of spontaneous regeneration and could be useful for planning reclamation interventions. This study aims to determine the effects of extreme heavy metal contamination and other adverse habitat factors that significantly affect the structure and species richness of pioneer communities on post-smelting dumps. Furthermore, we identified the relationships between the occurrence and abundance of particular species and specific environmental factors. Lichens, bryophytes and vascular plants in study plots of 1 × 1m, representing initial stage of vegetation, were examined and chemical properties of corresponding substrate samples were analysed. Species responses to habitat factors were identified using redundancy analysis. Stepwise multiple linear regression was used to determine the factors that mostly affect species richness. Both total and exchangeable Zn, Pb, and Cd, as well as Ca, Mg, C and pH are the main factors that influence the species composition and distribution. Three different responses to substrate contamination were recognised: species most tolerant and favoured by strong contamination, less resistant species appearing only on less contaminated dumps and cryptogams indifferent to heavy metal contamination and abundant on all dumps. The species richness and Shannon index of lichens and vascular plants respond differently and independently of one another in relation to heavy metal contamination and substrate fertility. Our results indicate that certain cryptogamic species are indifferent to enormous contamination and well adapted to slag substrate. In contrast, highly elevated levels of heavy metals negatively affect vascular plant species richness. Assemblages of pioneer cryptogams are an important element in the natural regeneration of post-smelting wastes and should be taken into account when reclamation activities are planned.

Poster B70

Regional species richness, species pool and community completeness of European plants: association with natural and anthropogenic factors

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The biodiversity of ecological communities is a traditional indicator for use in nature conservation. Traditionally, biodiversity has been limited to locally-observed species richness. Biodiversity, however, is affected by factors at both local and regional scales. Therefore, regional species richness is a vital metric. However, only those species with suitable habitat requirements can potentially inhabit a particular community. This ecologically-filtered set of species constitutes the species pool. The absent part of the species pool—dark diversity—allows us to quantify community completeness (how much of the species pool is actually realized). We examine how these biodiversity measures are related to different natural and anthropogenic factors at the European scale.

We used Atlas Florae Europaeae to quantify biodiversity in 50 × 50 km quadrates. Local richness is based on actual recordings in each quadrate. We defined regional richness for each quadrate by including all species from respective dispersion fields (area where species of the study quadrate are distributed). Species pools were calculated through ecological filtering of the regional richness according to species co-occurrence probabilities. Finally, Community Completeness Index was calculated: ln(local richness/dark diversity). We used spatially-informed models to associate these biodiversity measures to temperature, precipitation, land-use heterogeneity, agricultural land-use, human population size, and protected areas.

All biodiversity measures differed in their relationships to natural and anthropogenic factors. The main differences were in anthropogenic factors and some effects were even opposite (e.g., agricultural land-use was associated with low local and high regional richness). All measures except regional richness were positively related to high human population density and protected areas, which demonstrates both a threat and hope for European plant diversity.

To conclude, regional species richness is useful to understand and protect biodiversity. However, ecological filtering of regional richness is required to determine the appropriate species pool, dark diversity and community completeness.

Poster E185

Effects of different management regimes on the herb layer of grassland community

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Seminatural grasslands are species-rich communities that have formed and maintained as result of long-lasting low-intensity management like mowing and grazing. Due to drastical changes in agricultural land use practices the area of such grasslands has decreased and their diversity is seriously threatened. We studied experimentally the changes in species richness and the composition of plant traits on 40 sample plots (size 0,5 × 0,5 m) in dry acidophilous grassland plant community to understand the effect of traditional and modern management regimes. Four management variants have been applied:

1) once raked, once mown and hay removed;
2) once raked, twice mown, hay removed;
3) once mown, hay not removed (mulching);
4) twice mown, hay removed.

For every plot the list of vascular species was compiled and their coverage in % was estimated. The next traits for every species were found: growth form, leaf position, Grime`s life strategy type. For analysis of different parameters repeated variance analysis (ANOVAR) has been applied.

Mulching had the most important negative effect on species richness, while that has often used as cost-effective management method of grasslands. The mulching supressed the growth of rosette and hemirosette growth form plants. Raking favoured the growth of graminoids. Raking, mowing twice during summer and hay removal favoured plants with belowground vegetative propagation. The results of the experiment confirm that traditional methods of grassland management are the most effective for conservation of their biodiversity.

Poster A14

Specific leaf area correlates with temperature: new insights from the old story

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Previous studies indicate that temperature could explain only a part of the variation of specific leaf area (SLA). We assume that this is because 1) intraspecific variation of SLA values were not considered, 2) studies were focused on species level and 3) this relation was tested on single environmental gradients regardless of associated factors potentially determining complex responses of the trait. Using the original SLA values for 202 species occurring in 29 calcareous grasslands along a mean annual temperature gradient with a difference of 4°C (altitudinal gradient of 1400 meters), we explored the intraspecific, interspecific and community variations of SLA and investigated the relative impact of other environmental factors on this variability.

Results from the intraspecific level demonstrated that only 25% of the investigated species tend to change their SLA values along the temperature gradient. The comparison of SLA variations along the temperature gradient on the species and the community levels indicate that community-weighted values produced more accurate correlation between mean annual temperature and SLA ($r^2 = 0.04$ vs. $r^2 = 0.80$). The final linear model reveal that the correlation between SLA and mean annual temperature is modified by effects of disturbance and soil phosphorous content (9.8% and 8.9 % in model variation respectively).

Full advantage of a functional trait can only be realized if the trait is clearly linked to environmental gradients and ecosystem processes. Patterns described of SLA variability at different levels may help to improve the explanatory power of the trait as a predictor of species composition and ecosystem functioning along temperature gradient.

Measurements of relative explanatory power of environmental variables given by RDA and CCA are not always reliable

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Redundancy analysis (RDA) and canonical correspondence analysis (CCA) are widely applied methods in community ecology when the data at hand can be presented as a set of sites for which both species composition and several environmental factors have been recorded. Abundances of the species make the dependent variables and values of environmental factors form independent variables. In such a situation, the researcher often wants to know which independent variables are the best in explaining the species data. Both RDA and CCA are commonly used for obtaining such a ranking of the independent variables.

It has long been known that the absolute values of explained variance that RDA and CCA produce are not very important because the models that these methods fit for species abundances are rather simple. However, it has been assumed that the relative explanatory power obtained for the independent variables can be considered reasonable reliable. To our knowledge, this assumption has been tested in only one study. The study did find support for the assumed reliability of the rank order of the explanatory power of independent variables, but we have found that this study did not do the testing rigorously enough.

We built a simulated environmental landscape in which species abundances were determined by two mutually uncorrelated independent variables, X1 and X2. Half of the species were defined as specialists and half as generalists. Specialists had their abundances more strongly controlled by X1 whereas generalist species abundances were more strongly controlled by X2. The species filled the landscape uniformly so that the species were spaced at constant environmental distance from each other. Then we sampled the landscape with a gradually widening systematic grid of community samples and subjected each grid of community samples at a time for an analysis by RDA and CCA.

The results showed that both RDA and CCA switched the rank order of the explanatory power of the independent variables as the sample grid grew larger. This result shows that RDA and CCA can not give reliable results of the relative explanatory power of the independent variables when ecologically more specialist species respond to environmental factors differently from the response found among ecologically more generalist species.

Trait filtering in stable and dynamic grassland communities

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European calcareous grasslands are characterized by high diversity of habitat specialist plant species. During past century, calcareous grasslands have suffered a great decline in habitat area and quality, eventually leading to a decline in biodiversity. An understanding of the processes governing community assembly and colonization and extinction dynamics are crucial for developing strategies to mitigate biodiversity loss.

We conducted our study on 35 landscapes that contained grassland habitats with different land-use history. In each landscape, we sampled one well-preserved grassland patch as source habitat for grassland species. Adjacent overgrown grassland was sampled as a remnant habitat for grassland species. From the vicinity of each source and remnant habitat, we sampled a road verge as a sink habitat for grassland species. On each habitat patch, we counted the total number of vascular plant species at the community level (with a radius of ~50 meters) and in small scale (2 × 2 meters). We computed functional trait dissimilarity within small scale, within community and within regional species pools i.e. for all species in respective habitat types to observe effects of biotic and abiotic processes on species coexistence.

Both in overgrown grassland and in road verges, the trait convergence was detected in species assembly, i.e. the community and plot consisted of rather similar species from the pool of possible coexisting species. This indicates that there are certain requirements for the species that colonize or persist in dynamic habitats. In open and stable grasslands trait convergence was detected only in larger scale, while divergence (functionally different species coexisting together) or random patterns prevailed in small level. Historical stable grasslands are assembled differently from dynamic habitats as, often, species that are functionally different coexist together. In less stable habitats trait filtering more strongly select for species with given functional traits.

Poster D126

Chemical cues produced by plant roots mediate neighbour recognition and trigger complex behavioural changes

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Competition between plants for belowground resources has been predicted to result in the so-called tragedy of the commons: the presence of competitors is expected to trigger increased biomass allocation to root growth, which improves competitive ability, but results in reduced resource acquisition efficiency and lower fitness. It has also been demonstrated that some plant species are capable of discriminating between closely related (kin) and unrelated competitors, displaying selfish root proliferation in the presence of unrelated competitors but restraining root growth in the presence of kin. The mechanisms by which plants determine the presence and identity of neighbouring roots remain largely unknown.

The aim of this study was to test whether root exudates could mediate recognition of neighbour identity in plants and trigger responses indicative of selfish or cooperative behaviour. Individuals of Deschampsia caespitosa were subjected to root exudates that were collected from siblings, unrelated conspecifics from the same or a different community, and representatives of a different species (Lychnis flos-cuculi) from the same community or a different community. The results showed that plant root exudates can carry specific information about the genetic relatedness, population origin and species identity of neighbours and also trigger different responses at the whole root system level and at the level of individual roots. Root proliferation was mainly achieved through changes in morphology rather than biomass allocation, suggesting that plants are able to limit the energetic cost of selfish behaviour. These findings reveal a new level of complexity in the ability of plants to interpret their surroundings and react accordingly.

Long-term mountain tundra dynamics under grazing and environmental changes

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In a global changes context, northern tundra is also changing in a commonly described as greening and shrubification processes. However, combined effects of climate and land-uses changes, the main anthropogenic drivers of arctic tundra, are poorly known in particular at the plant community scale. On the other hand, studies addressing the relative importance of biotic and abiotic drivers of tundra plant communities' composition provided conflicting evidence mainly due to their short-term issues.

We proposed to use the results from a long-term experiment set up in 1989 at Kilpisjärvi in the north-western Finnish Lapland to explore to what extent local abiotic and biotic conditions could influence the dynamic of communities under environmental changes. The experiment consisted in the transplantation of twenty 40X50 cm blocks of *Vaccinium myrtillus* heath including 5-10 cm thick soil layer from a 660 m.a.s.l. dry slope to a snowbed 150m higher in elevation containing dry and wet sites. We considered the transplantation at higher altitude in snowbed conditions an increase in harshness (shorter growing season, lower productivity). Half of the transplanted blocks were protected from herbivores and the cover of each plant species was yearly estimated from 1989 to 2001 in a central 25X25 cm area in each block using pin point method. Late August 2012, the cover of each plant species was again estimated and these 11-years older points were compared to the trajectories drawn by the first 12 years.

Our results highlighted the divergence of community trajectories under the combinations of treatments. They showed that the dominance of the shrub *V. myrtillus* was strongly reduced as response to transplantation to snowbed and that graminoids and forbs cover increased. Soil wetness favored the bryophytes cover. In dry sites, herbivory exclosure some species assumed high dominance reducing the community diversity, the dominance of *V. myrtillus* leading to the lowest diversity level largely composed by vascular plants.

The long-term monitoring of plant community composition of Arctic mountain tundra under the combined effects of multiple drivers allowed us to draw divergent community trajectories towards alternative plant community states. These states could be diverse in terms of plant community structure and morphological and chemical species functional traits. Finally such changes in plant communities could induce changes in interaction and feedback between biotic and abiotic compartments of the ecosystem.

Effects of anthropogenic forest fire on the regeneration of boreal forests in semi-arid regions of Mongolia

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Forest fire is an important disturbance facilitating regeneration in boreal forests. On the other hand, it has been pointed out that the anthropogenic forest fire might degrade boreal forests and change them into grassland in Mongolia. It has been thought to be the reason that forest fire tends to become large-scale fire in the semi-arid environment and the anthropogenic fire aims for illegal cutting of remaining trees in the post fire sites. However, it has not yet been clarified in detail how such an anthropogenic fire affects the regeneration and degrades forests. Therefore, the objective of this study was to demonstrate effects of anthropogenic forest fire followed by illegal cutting on the regeneration of boreal forests in Mongolia. For the purpose, we conducted field survey in a post fire site, where a large-scale fire occurred in 2005. The study site (lat. 48°15′N, long. 106°50′, 1,180 m a.s.l.) is located in the forest-steppe zone. From the remaining forest to post fire site, we recorded density of saplings invading after the fire, exposure degree of mineral soil, and location of stamps of trees cut after the fire. The results showed that regeneration of *Larix sibirica* and *Betula platyphylla* is facilitated by the forest fire, but that of *Picea obovata* and *Pinus sibirica* is not. It was likely that regeneration of *L. sibirica* and *B. platyphylla* occur in exposure of mineral soil, establishment of saplings depends on the distance from the remaining forest that functions as seed source, and saplings of *B. platyhpylla* are established in the more distant areas from the remaining forest than those of *L. sibirica*. In forest fire, *B. platyphylla* loses aboveground organ but has long seed dispersal distance from remaining forests because of the light seeds. On the other hand, *L. sibirica* that does not have so long seed dispersal distance as *B. platyphylla* remains aboveground organ because of the fire tolerance and has seed dispersal from those remaining trees, but the remaining trees are illegally cut. Consequently, large-scale fire followed by illegal cutting probably reduces the regeneration of coniferous tree species, which enlarges mostly pure stands dominated by *B. platyphylla*, and changes forests into grassland, where the seeds are not dispersed.

Poster D151

Why did the black locust *(Robinia pseudoacacia)* expand broadly in the river basin in Japan?

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The black locust (*Robinia pseudoacacia* L.), a tall deciduous tree belonging to the Leguminosae and a native of the Appalachian Mountains in the United States, now occurs worldwide. It was first introduced to Japan from Europe in 1873, when it was used as a roadside and garden tree and for erosion control. It has subsequently spread over Japan via plantations and natural regeneration. Currently, the management of this tree poses a major problem in a wide area of Japan, as the spread of this tree has caused a crisis in biodiversity through its exclusion of native plants.

Why did the black locust expand broadly in the river basin in Japan? The cause is in the special life history of a black locust. The black locust has ecological characteristics that are very interesting at each stage of its life history, especially in seed germination and root suckers. It has two seed types: nondormant seeds that can germinate immediately after seed dispersal in autumn and dormant seeds covered by a hard seed coat that form a dormant seed bank in the soil without germinating until the following spring. The time of seed germination is not fixed under natural conditions, and disturbance can trigger germination. For example, seed germination often occurs on new fine deposits after a flood. The initial growth in the first year is very small, but the seedlings subsequently grow quickly to 2–3 m in height and come into bloom in 3 years. This early growth is dependent on a high photosynthetic rate under optimal conditions. Black locust is a typical tree with a shallow root system. Many root suckers emerge from the horizontal roots either when cut by humans or under natural conditions, and these root suckers elongate away from the mother tree, which will expand a patch of black locust. This alien species has expanded its range from upstream to downstream regions as a consequence of natural disturbances such as flooding. Once established, it spreads via root suckers.

Key words: Dormant seeds, Flooding, Invasive alien species, *Robinia pseudoacacia*, Root sucker

Poster D152

Land developments affect the distribution pattern of alien plants in Fuchu, Tokyo

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Fuchu is an urban city located in the middle of Tokyo, Japan. Within Fuchu there remain some vegetated areas including parks and shrine and temple forests. Researchers have recently found alien plants that had not been seen in the area before and are expanding their distribution.

The purpose of this study is to identify the effects of urbanisation on the distribution of alien plants. We also examined the effectiveness of using governmental districts as a research unit.

We recorded all of the plant species that appeared in each district. This survey was taken twice a year (spring and autumn) between 2004 and 2012. The collected data has been analysed by using the statistical software R and ArcGIS.

In total, 1022 plant species were recorded of which 418 species were non-native species. The average total number of species and alien species in each district was 158 and 60 respectively. The research showed that the average proportion of alien plants was significantly lower in lowland areas as compared to terrace areas. There was a significant positive correlation between population density and the proportion of alien species and a negative correlation between the ratio of green coverage to the proportion of alien species. These results show that alien plants tend to be seen more readily in the districts with lower levels of vegetated area and high population densities. In other words, alien plants are more successful in highly urbanised areas.

Another finding is that the composition of frequently appearing alien species differs depending on the level of urbanisation. A remarkable finding was that many *Poaceae* such as *Bromus catharticus* dominated in districts with high green coverage. On the other hand, in districts with less green coverage, many of plants were garden plants such as *Pyracantha coccinea* and *Talinum crassifolium*. These species are likely from domestic gardens and have been expanding their distribution. Through this study, it was noted that governmental district units were useful in analysing the relationship between the distribution of alien species and urbanisation. This was because terrain data was available for each district. In addition, the boundaries between districts were readily identifiable in the field allowing expedient data collection.

In conclusion, urbanisation encourages alien plants to grow and also changes the composition of the plants. More detailed urbanisation effects and patters of plant distribution can be clarified by further research.

Poster D112

Communities of arbuscular mycorrhizal fungi in plant roots: more diverse than those in soil?

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In this study, we analyzed arbuscular mycorrhizal fungal (AMF) communities in plant root samples from a natural forest ecosystem – a primeval forest at Järvselja, Estonia. AMF small subunit (SSU) ribosomal RNA genes were subjected to 454-pyrosequencing and BLAST-based taxonomic identification. Seventy-six AMF sequence groups (virtual taxa, VT) were identified from plant roots.

Taken together with seven further VT recorded in an earlier investigation of soil AMF communities at the site, this represents the highest number of AMF reported from a single ecosystem to date. The six plant study plant species hosted similar AMF communities. However, AMF community composition in plant roots was significantly different from that in soil and considerably more VT were retrieved from roots than from soil. AMF VT identified from plant roots as a whole and from individual plant species were frequently phylogenetically clustered compared to local and global taxon pools, suggesting that non-random assembly processes, notably habitat filtering, may have shaped fungal assemblages. By contrast, the phylogenetic dispersion of AMF communities in soil did not differ from random subsets of the local or global taxon pools.

Keywords: arbuscular mycorrhizal fungi; microbial ecology; microbial communities; symbionts; soil microbes

Poster B60

Response of boreal forest vegetation to the climatic factors, soil fertility and stand structure in eastern Fennoscandia

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Finland and Russian Karelia (including Karelian Isthmus) are both located on the ancient Precambrian Fennoscandian Shield, and biogeographically they belong to the boreal vegetation zone. In terms of climate and soil, the natural growth conditions of forests in Finland and in Russian Karelia are relatively similar, but structurally the forests and tree stands differ significantly between the countries. Differences in the forest use history and in silvicultural practices during the past 70 years have driven the development of forests in these two countries to different directions.

In this study we analyze the variation in the understorey vegetation of upland forests in relation to climatic factors, soil fertility, and stand structure in eastern Fennoscandia using ordination and GIS techniques. The study material is based on an extensive systematic survey carried out in Finland in 2006–2007 (EU Forest Focus BioSoil) and in Russian Karelia in 2008–2009 using comparable methods. The data (between latitudes 60oN and 66oN) includes information on plant species richness and percentage cover, tree stand characteristics, chemical variables of soil, and modeled climatic indicators on 374 permanent plots in Finland and 134 plots in Russian Karelia.

The species composition was relatively similar on both sides of the border, though certain eastern flora found in Karelia and Karelian Isthmus was lacking in Finland. In the NMDS ordination the plots were located in accordance with the dominating tree species (Scots pine > Norway spruce > *Betula*spp. > *Aspen* and *Alnus* spp.) indicating that soil fertility level (stand productivity) is the main compositional gradient. The most species rich forests were found in SW Finland and Karelian Isthmus in areas with high Ca concentration and high pH in soil. In addition to fertility, location along south – north gradient caused differentiation in forest vegetation giving information for the zonation of boreal forests. Vegetation in Karelia resembled the middle boreal and that of Karelia Isthmus the southern boreal vegetation in Finland.

Poster B75

Habitat effects on cacti communities in southern Brazilian Pampa biome

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Habitat can affect species composition due mechanisms related to species sorting. Environmental and biotic variables may determine specificities that allow permanence of species in some habitat due distinct processes generated by such conditions. The coexistence of different species at one location does not depend only on their capacity to arrive, but also from their environmental requirements and ontogenetic habitats shifts. Different processes can assume distinct importance varying scale, that's why we provided a microscale approach as the first step to understand the relationship between cacti species composition and biotic/abiotic habitat variables along different plant ontogenetic stages.

The study area comprises southern Brazilian Pampa biome, where grasslands are interspersed with rocky outcrops and climate is humid subtropical. Sampling was nested into four scales. 16 rocky outcrops contained linear transects of contiguous 1m2 quadrats subdivided into 100 cm2 microsites. For microsites we recorded cacti individuals, estimated their body area and classified ontogenetic stages. Habitat was described by frequency of occurrence of several categorical variables. Biotic variables included life forms nearer to cacti individuals, while abiotic consisted in microhabitat and substrate traits. We performed Redundancy Analysis to assess the relationship between species abundance and habitat variables.

We recorded 1216 individuals from eight species and three genera across 721 microsites. *Gymnocalycium denudatum* dominated (53% of individuals), followed by *Parodia lagnsdorffii* (15%) and *Frailea phaeodisca* (13%). Microhabitat explained 21% of total variation in cacti abundance, substrate 18% and life forms 21%. Microhabitat explicated 20% of seedlings and substrate 23%, been rifts and litter especially important for *P. mammulosa* and soil for *P. ottonis*. Juveniles were 11% explained by substrate, with soil been appropriated to *G. denudatum* and lichen to *P. ottonis*. Biotic variables explained 17% of seedlings variation, 16.5% of juveniles and 14% of adults. Juveniles and adults of *G. denudatum* were associated mainly with herbs and creeping shrublets, whereas lichen was important for adults of *P. ottonis*.

Only three species showed habitat preferences at microsite scale. Litter deposition in rifts favors *P. mammulosa* germination, whilst *P. ottonis* germinate directly on soil, with juvenile survivorship depending on lichen. Soil seems the substrate requirement for *G. denudatum* juveniles and other until juveniles and adults stages.

Effects of gap creation in an urban forest dominated by evergreen broad-leaved trees

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The Expo '70 Commemorative Park in Osaka, Japan, was constructed after the World Exposition in 1970. In the area designed as 'dense forest', covering approximately 0.26 km^2, revegetation was conducted from 1972 to 1976, using mainly evergreen broad-leaved trees, which are the climatic climax vegetation in this warm-temperate zone region. Presently, nearly 40 years after the reclamation, the planted trees have reached heights of up to 20 m, and in most areas the canopies are closed. However, forest regeneration has not been sufficiently achieved in terms of biodiversity, because many of the planted evergreen trees have similar canopy heights, and light conditions at the forest floor level are poor, resulting in a lack of understory vegetation and a simplified forest stratification. In addition, the park is surrounded by urban area, which inhibits the introduction and colonization of certain indigenous species from neighbouring forests.

As an adaptive management strategy to address these problems, canopy gap creation mimicking forest gap dynamics has been performed since 2001. In addition, the spreading of topsoil from neighbouring forests has also been undertaken, with the aim of introducing soil seed banks. In the gaps created after 2005, consecutive monitoring of light conditions and the growth and death of tree seedlings has been conducted. Here, we discuss the monitoring results for some of the created gaps.

The light conditions were revealed to have been improved immediately after gap creation. Thereafter, however, light conditions deteriorated with the growth of pioneer tree species and stump sprouts of evergreen trees, and approximately 3 years after gap creation light levels had returned to the pre-gap creation levels. Many deciduous tree seedlings, such as those of *Celtis sinensis*, germinated during the first year after gap creation, but most of these died as the light conditions began to deteriorate. In contrast, a few evergreen broad-leaved trees, such as *Quercus glauca* and *Ligustrum lucidum*, were less affected by the deterioration of light conditions, and had survived at high rates at 3 years after gap creation. Plant coverage was higher and the number of plant species was larger in the area that had received a spreading of topsoil. Some plant species appeared to have germinated from the imported soil seed bank. In the future, further consecutive monitoring and appropriate management will be important for the development of a forest that is rich in biodiversity.

Poster B61

Comparison in forest carbon stocks among different canopy conditions in two typical dipterocarp forest types, Peninsular Malaysia

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Objective

Reducing carbon emission from deforestation and degradation in developing countries (so-called 'REDD-plus') is a key issue of climate change mitigation. Because forest carbon stock measurement is indispensable for the REDD-plus implementation, long-term monitoring of forest dynamics can facilitate the accurate estimation of the changes in forest carbon stocks. To investigate the temporal and spatial changes in carbon stocks, we estimated the aboveground biomass using tree census data from LTER (long-term ecological research) sites in Peninsular Malaysia.

Methods

Since 1992, we have been conducting long-term forest dynamics studies at two 6-ha plots (Semangkok and Pasoh) located in Peninsular Malaysia. The Semangkok plot is a hill dipterocarp forest dominated by *Shorea curtisii*. The Pasoh plot belongs to the lowland dipterocarp forest. In 2011, we performed a canopy gap census at the plots. Each plot was gridded into 2,400 (5 × 5 m) quadrats. A canopy gap was defined as a subplot having a canopy height of 5 cm were censused in 1993 and 2011 at Semangkok and in 1996 and 2010 at Pasoh.

Results & Conclusions

The observed percentages of quadrat in the "gap" class were 14.2% in Semangkok and 15.6% in Pasoh. Since no severe disturbance (e.g., fire, wind storm) occurred on both the plots, the overall tree mortality rate was 1.75%/y in Semangkok and 1.95%/y in Pasoh. Aboveground biomass under the Gap sub-plots was relatively smaller (<200 mg/ha) than the Closed ones (ca. 530 mg/ha at Semangkok and 420 mg/ha at Pasoh). Aboveground biomass in the Gap sub-plots decreased over the inter-census interval due to mortality of some canopy trees. On the other hand, the Closed sub-plots showed slightly increased biomass during the same period despite large variations in mortalities. These results suggest that canopy gap distribution monitoring is important in understanding forest carbon dynamics.

An investigation of the relationship between herbaceous species richness and soil nutrients at the square meter scale

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J.P. Grime's humped-back model (HBM) predicts that species richness reaches a maximum at intermediate productivity and drops off at low and high productivities. Soil nutrient availability is known to influence primary productivity and plant species richness. In general, productivity increases with increasing soil nutrient availability and experiments that increase soil nutrients often show increases in biomass with corresponding decreases in species richness. As such, certain patterns in soil nutrients are expected to coincide with the HBM. The goal of our work was to identify patterns between soil nutrients, and species richness relationships using soil samples collected from four multi-scale grids (8 × 8 m grids containing 64 1 m² plots). Total carbon and nitrogen content were analyzed with a CE-440 Elemental Analyzer and total Al, B, Ca, Cu, Fe, Mg, Mn, P, K, S, and Zn were prepared by VHP closed vessel microwave acid digestion and analyzed using an ICP spectrometer. The first axis of the nonmetric multidimensional scaling (NMS) analysis of soil nutrients was strongly positively correlated with plant dry biomass ($r^2 = 0.68$). Nitrogen and carbon were positively correlated with biomass, while copper and iron were negatively correlated. As predicted, the first NMS axis had a unimodal relationship with species richness at the square meter scale. Our results suggest that nutrient availability is an important factor in controlling herbaceous plant species richness.

Competing plant functional types: A dynamic, spatially explicit model for landscape scales

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There is an apparent lack of non-statistical models that are able to generate maps of plant communities across complex landscapes featuring strong temporal dynamics. Such models should be able to deal with non-analogous conditions and extreme events like droughts or mechanical disturbance events.

Our objective is to generate vegetation maps from a set of plant functional types that disperse, live, die and compete following simple, expert-defined rules. The model should be as parsimonious as possible and match the perception of field ecologists in order to allow for an easy adaptation across regions.

The dynamic model is written in C++/Qt and uses an environmental filter system that is complemented by simulations of dispersal, competition and persistence. Competition is based on different abilities to use the resources of a site and to persist under unfavorable conditions or after extreme alterations of the environment. Disturbance plays a crucial role in shaping the spectrum of occurring plant functional types. Conceptually, this includes most types of land use but also non-recurrent events. The spatial resolution is 10 – 50 meters with a maximum extent of 10^3 by 10^3 pixels for an individual application. Outputs are at a monthly base.

Adaptation across regions is realized by adding plant functional types with the respective response schemes. A simple to use editor provides an interface for constructing such types. The required input data is as simple as possible: Apart from the definitions for a pool of plant functional types with their responses to environmental conditions (many of them come with the software) a set of raster layers is needed that describe the environmental changes in time. In most cases this includes layers describing temperature, precipitation and mechanical alterations. Additional filters include soil depths and topographic position and can be kept constant.

Although first results and test runs can be presented the model is still considered under construction. We hope that our non-probabilistic approach that takes into account expert knowledge about ongoing processes can close a gap and provide realistic, dynamic scenarios at a scale that is relevant for land-use management and conservation.

Shades of green: facets of biological diversity of Swiss dry grasslands

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The traditional currency of biological diversity is species richness of a given area. There is increasing evidence, however, that functional and phylogenetic diversity are more important than species numbers to explain ecosystem processes. While there is a growing body of work taking these different aspects and their interrelationships into consideration, attempts to relate them to environmental conditions remain scarcer. In the present study, we computed taxonomic, phylogenetic and functional diversity as Rao´s quadratic entropy for a large number of Swiss dry grassland plots and related those values as well as species richness to environmental variables using permutation linear models. There was a weak positive relationship and considerable mismatch between the different measures of biodiversity and the environmental variables explained little of the variation. Nevertheless, they predicted species richness, taxonomic and phylogenetic diversity a lot better than functional diversity. These results suggest that different aspects of biological diversity are affected differently by the environment and that a positive relationship between them cannot be assumed per se. This has consequences for attempts to conserve and understand the functioning of these systems, especially in the light of changing environmental conditions.

Seed addition via epizoochorous dispersal in restoration practice: an experimental approach mimicking the colonisation of bare-soil patches

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Loss and fragmentation of semi-natural grasslands are major threats to populations of rare plant species in the present Central European landscape. To provide connectivity between fragmented grasslands moving sheep flocks can be effective seed dispersal vectors.

The ability of epizoochorously dispersed diaspores to establish and build up populations on newly created, managed restoration sites on sandy bare soil was one aim of our study. Additionally, the persistence of epizoochorously-induced spatial patterns was studied and the subsequent development of a community.

To answer these questions, a six-year experiment on sheep-epizoochorous dispersal was conducted on three newly created deep sand-deposition sites in the upper Rhine valley, Germany, mimicking restoration areas with abiotic improvement (nutrient-poor conditions). Establishment success and persistence of ten epizoochorously dispersed species typical for FFH-inland sand vegetation were assessed. Spatial patterns were analysed by the use of SADIE (Spatial Analysis by Distance Indices). Vegetation development of the experimental areas was related to their adjacent surrounding and a nearby nature reserve (target species ratios, NMDS ordination). In addition, seed rain and early-successional soil seed bank were sampled.

All except one species in the epizoochory experiment became established during the studied time period. Most perennials had stable or increasing abundance values over time, whereas annual species fluctuated across years with high abundance in some years. Spatial patterns were aggregated for most study species. Similarity of spatial patterns between consecutive years has varied by species, site and year and was found to be stronger in perennial species than in annuals. Patterns of seed dispersal and establishment were positively associated with each other (a subset of three species was tested). NMDS revealed similarities in the three experimental areas, which was related to the vegetation of the surrounding grassland. Within six years the proportion (but not the cover) of target species reached a level similar to that in a nearby nature reserve; however, many species characteristic of the nature reserve were absent. The species compositions of both seed bank and seed rain were dominated by non-target species.

Moving sheep flocks can assist the colonisation of grassland species on newly created bare soil areas via epizoochory. The incorporation of moving livestock into restoration projects may facilitate the regeneration and preservation of threatened plant populations in fragmented landscapes.

Comparison of understorey vegetation of coppices and high beech forests. A case study from the Banat region

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Coppicing and its role on biodiversity or biomass production became very popular topic in nature conversation and forest management in last 10 years. The central-european broad leaved forests were affected by this management for several centuries. In the Czech Republic it was commonly practicing up to the first decades of 20th century. After that the high commercial forests were established. This essential change of forest structure should strongly affect all components of forest ecosystem, however, in central Europe it is difficult to study this changes according to lack of suitable forests, where the coppicing have persist up today. Only, but very good possibility, is to use analogy. Coppice stands are still very common in Banat region in Romania, therefore our research was placed there. The objectives of this study are: 1) determination of the major rules explaining herb vegetation diversity pattern in limestone beech forests relative to their management. 2) Analysis of the relationship between the tree and herb layer of the limestone beech forest. Two sets of relevés were used in this study, both obtained in limestone beech forests in two types of management: coppices and high forests. All chosen sites were within areas of relatively homogenous forest vegetation in order to reflect typical structure and composition of vegetation. Relevés were collected in the 2012 on 60 square plots (30 in coppices and 30 in high forests) sized 100 m². As a stratum for relevé selection a represent type of management at similar environmental conditions were used.

The results showed clear trends in species diversity when coppices and high forests were compared. The total number of species, the mean number of species per site and diversity index was higher for the intensive managed coppices in comparison with high forests. The main gradient in the herb layer also reflected difference in management. In the high forests vernal geophytes (Allium ursinum, Anemone nemorosa) and sciophytes (*Mercurialis perennis, Mycelis muralis, Dactylis polygama*) had the highest frequency. In contrast, the frequency of (hemi-)heliophytes (*Viola alba, Glechoma hirsuta, Thlaspi perfoliatum, Poa angustifolia, Aremonia agrimonoides, Potentilla micrantha*) was significantly higher in coppice stands. We assume that these differences are primarily related to open canopy (higher influx of light energy) and disturbed soil surface in coppices.

Poster E187

Does type of forest establishment influence composition of herb layer in floodplain forest?

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One of the most widespread forms of forest disturbance is clearcutting and complete soil preparation for establishing of new forest. The knowledge of long-term impacts caused by forest management practices on herb vegetation is a crucial factor for harmonization a nature conservation and a forest management as well. The Thaya river alluvium protects one of the most preserved floodplain ecosystem in the central Europe (Biosphere reserve Dolni Morava). Unfortunately, the intensive forest management and without paying attention to environment protection has been providing there.

The influence of mechanical site preparation on vegetation and diversity of herb layer was assessed in commercial floodplain forest in the Thaya river alluvium. Survey was carried out during summer 2012 in 10–50 years old forest stands with different type of forest establishment (with or without mechanical site preparation). Altogether 160 relevés (80 from peduncle oak stands and 80 from ash stands) were selected for analyses. Relevés were analyzed using multidimensional statistics and plant community characteristics (fidelity, Simpson's index, life forms, rate of alien or endangered plant species). The results showed that mechanical site preparation did not affect herb species composition and number of herb species. There were significantly affected species richness of neophytes, invasive plant species and diversity index. The sites without forest floor treatment contained significantly less number of alien species. Invasive plant species as *Aster lanceolatus* and *Acer negundo* were more abundant in sites influenced by mechanical preparation of soil.

If mechanical soil preparation is realized, the fragmentation of viable stolon follows. It can cause propagation of population of *Aster lanceolatus*. The high saturation of alien species of nearby forests, disruption of soil surface and propagation of stolon fragments are the main causes of increased abundance and/or dominance of the alien species in the area. We suppose that the forest management in the Biosphere reserve should be in accordance with preserving of native species diversity and it should balance the economic effects as well. It seems that forest restoration practices with mechanically disturbed soil surface have had negative impact to the plant diversity and have caused a propagation of alien species. Probably the invading of alien species causes postpone of autochthonic species to the edge of theirs optimum. Finally, it can have negative impact on populations of endangered and autochthonic species.

Poster D142

Early post-disturbance carbon dynamics following wildfire and harvesting in the boreal forest

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Boreal forest store large amounts of carbon (C) and play an important part in global C cycle. Historically fire has been the main driver of ecosystem processes and C dynamics in North American boreal forest. Higher and higher demands for forest products have made forest harvesting also a disturbance with significant importance. Although a lot of work has been done to quantify C in boreal forest, significant knowledge gaps remain (e.g. dead roots, fine and medium roots, stumps) and studies reporting total ecosystem C (TEC) are scarce. In this study we explore in detail how these two disturbances compare in terms of C dynamics. C in ecosystems is in four main pools; live biomass, dead biomass, forest floor and mineral soil. These pools are different in their behaviour and function and interact during stand development when C is being allocated form one pool to another. We quantified all C pools after wildfire and clearcut harvest in a chronosequence ranging from 1 to 27 years in the boreal mixedwoods of central Canada. The comprehensive data set gives a clear detailed overview of early C dynamics. TEC was related to time since disturbance, but no difference was detected between disturbances. Our results are in general agreement with other studies reporting TEC. Following harvest, TEC declined from 146.2 to 127.7 MgCha^{-1} and then increased to 185.1 MgCha^{-1} by year 27. After fire, TEC declined from 133.8 to 127.6 MgCha-1 and increased to 163.6 MgCha^{-1} by year 27. Total biomass, forest floor and mineral soil C changed differently after disturbances while dead wood had similar dynamics. On average mineral soil contributed 38% of total C, followed by dead wood (29%), forest floor (20%) and live biomass (13%). When to consider that merely top layer of forest floor is visible, the share of invisible C in the beginning of forest development is very high, 80% and 67% after harvest and fire, respectively. Current management practices (i.e. harvesting and planting) in boreal mixedwoods have no negative impact on TEC. Considering also the life cycle of products made from harvested wood and the displacement effect (i.e. use of wood instead of concrete or steel that have higher C footprint), harvesting result higher C uptake from the atmosphere compared to natural forests, therefore moderating climate change.

Habitat islands as a model to study relationship between fine-scale species richness and the size of species pool

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There is evidence that local species richness (i.e. number of species occurring in certain plot) is influenced not only by environmental conditions and biotic interactions, but also by the size of species pool. However, to study relationship between local species richness and the size of species pool using observational data, we need to vary the size of species pool, but to keep other factors (such as environmental variables) constant. We believe that suitable landscape model to test this relationship are habitat islands of dry acidophilous grasslands in cultural landscape. In our concept, the size of species pool influencing local species richness is surrogated by the number of species actually present at certain habitat island. We assume that changes in the island area naturally manipulate the size of species pool (larger islands have more species than smaller), while keeping environmental conditions reasonably constant.

The aim of our study is to show the relationship between local species richness and the size of species pool, naturally changing with the area of habitat islands.

Data concerning vascular plant species were collected in habitat islands with semi-natural acidophilous grassland vegetation in agricultural landscape during 2008–2012 in Třebíč region, Czech Republic. These habitat islands occur in the area of 26 km^2 under reasonably similar environmental conditions. On each of 50 sampled habitat islands, number of species within four randomly placed plots 50 × 50 cm was recorded, as well as all species occurring at the island. The relationship between the number of species recorded on the whole island representing the local species pool for a plot, area of the island and the number of species recorded in a plot representing the local species richness was analysed. Results showed the positive relationship between local species richness and size of local species pool (i.e. number of species on the island), which means that plots located on larger islands with more species are more species rich. In our opinion we found functional model to demonstrate the relationship between local species richness and the size of species pool, in which the plot "samples" species from species pool.

Effects of dwarf pine on vegetative propagation of Norway spruce in the treeline ecotone

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As temperatures increase globally, one might expect that altitudinal margins of tree stands will advance upwards. However, range expansion of trees could be significantly affected by both negative and positive interactions with alpine shrubs at existing treeline ecotones. Here we examine the effects of prostrate dwarf pine (*Pinus mugo*, Turra) on vegetative propagation of Norway spruce (*Picea abies* L., Karst) in the treeline ecotone of the Hrubý Jeseník Mountains, Czech Republic. In the treeline ecotone, vegetative propagation is important both for the expansion of groups of spruce originally derived from generatively produced individuals and for the persistance of already established spruce groups. We analyzed how the density of dwarf pine stands and the distance from their margins influence vegetative reproduction of spruce. We found that increasing density of dwarf pine stands strongly reduced vegetative propagation of spruce, with spruce clonal groups surrounded by dense pine stands having fewer layering branches and juvenile trees than such groups growing outside pine stands. We recognized the distance of about 6 m between spruce and pine as a boundary beyond which dwarf pine appeared to not have a negative influence on spruce vegetative reproduction. Our results indicate that dwarf pine stands slow spruce upward expansion in the treeline ecotone.

Tree-line advance in the East Sudetes – can diversity be lost?

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In the East Sudetes , which represent mid-mountains of central Europe, we ascertained the expansion of treeline ecotone to higher altitudes based on the dendroecological methods. We found out favourable age structure of Norway spruce (*Picea abies* L., Karst) populations even in the topmost parts of the East Sudetes. The actual generative reproduction above upper limit of the closed forest was successful, the seedlings density within the height class from 10 to 80 cm ranged from 29 to 35 specimens per hectar. In addition, the cones with viable seeds were found even in the topmost part of the study area. Moreover, the high intensity of vegetative reproduction of Norway spruce was recorded. We found in average 12.8 clonal offsprings originated from one parent tree and up to 5 clonal trees originating from one primary rooted branch. Treeline advance and densification are results of a decades-long effect of natural processes and the absence of the direct human influences. If the natural succession provided by the status of national nature reserves will continue, fragmentation of alpine biotopes can be expected. It can result in decreasing diversity. Soon, the nature protection authorities will have to decide whether to protect natural processes or significant biotopes often conditioned by historical management and the following successional processes.

Community-level effects of plant-plant co-evolution and underlying mechanisms in calcareous grasslands

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Interactions between plants play an important role in community assembly. In addition to direct competition for resources, plants may interact via organic exudates produced by plant roots and soil microbiota may play a significant role in mediating interactions between plants. The time that plants have had to co-evolve within a community may influence the mechanisms of plant interactions and community functioning.

The aim of this study was to determine a) whether local adaptation between the component species of a community is important for community productivity and structure and b) to establish the role of root exudates and soil microbial community in mediating interactions between plants with versus without a history of local co-existence. We performed a pot experiment that combined 3 treatments in a fully factorial design: 1) the role of local adaptation to neighbours was studied by growing together plants that originated from the same community or from two different communities; 2) the role of chemicals released by plant roots were studied by using activated carbon, which neutralizes the effect of chemicals in the soil; 3) the role of soil microbes was studied by sterilizing and inoculating the soil. The seeds that were used in the experiment were collected from four calcareous grasslands with a long history of use as pasture: western Estonia, two Swedish islands and southern England. At the end of the first growing season, aboveground parts of all the plants were cut at the height of 1 cm and the biomass of each species in a pot was dried and weighed separately. Species richness, community productivity, evenness and diversity were determined and the effects of applied experimental treatments on community properties were assessed.

A multimillennial perspective on disturbance dynamics and the boreal forest structure

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The key to unravel the history and long-term dynamics of the boreal forest lies in the sediment layers of bogs, lakes, and small depressions and in their rich content of microscopic and macroscopic pollen, charcoal, and other fossil remains. These fossil records have so far contributed only little to the understanding of the boreal forest dynamics and the role of disturbances, climate and other drivers of change. This is bound to change, however, due to the realization that investigations of long-term forest ecology must be based on fossil records with temporal resolution of few tens of years, thus high enough to be comparable with forest-ecological studies. Equally important is that the fossil records are from sites that are ideal in terms of their location and size (radius in m), so that that the source areas reflected by their fossil assemblages matches that of the forest patches under investigation. When the results of past forest reconstructions from northern Europe are examined and synthesized, the responsiveness of the boreal forest is highlighted. One conspicuous feature is the fluctuating population of spruce, the current end-successional species of the old-growth forest in Fennoscandia, with an average biomass ranging from 20 to 60 t ha-[1]. However, the pollen records show that the spruce population may have been 2 or 3 times higher 3000-1500 years ago and has decreased strongly during the last 1-2 millennia. The potential reason for the decline is increasing land use and deforestation. However, new data show that this decrease is a large-scale feature in northern Europe, beginning roughly synchronously 1500-1200 years ago in western Russia, Finland, Estonia, and central Sweden. New climate model simulations shows that the decline has happened parallel with a precipitation decrease and therefore this millennial declining trend has probably not been caused solely by human disturbance. Rather the decrease has been driven by decreasing humidity, and has been accelerated by the forest clearance and human-induced fires, especially in connection of slash-and-burn cultivation. Another example of distinct population changes is the transient decline of alder at 1300-1000 years ago, detected in high-resolution pollen diagrams in Estonia and Finland. This decline has also been linked to human activity, but it is unclear what type of human activity would decimate alder population without causing a decline of other deciduous tree species. It therefore represents an example of difficulties of attributing past boreal forest composition change to causal factors.

Diverse aquatic vegetation at the foot of Mt. Fuji, central Japan: anthropogenic effects on the vegetation and its habitats

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Mount Fuji (3776 m alt.), a dormant volcano, is the highest mountain in Japan. Although there is no wetland on its top and slopes, there are diverse habitats of aquatic plants at the foot of the mountain. These wetlands have been affected by various human influences from the past to the present.

Mount Fuji is covered with permeable volcanic deposits. Therefore rain and snow falling on the mountain sink underground and surface as springs at the foot of the mountain. The spring water is transparent and its temperature is stable with temperatures of 12-16°C throughout the year. The vegetation of spring water is characterized by *Ranunculus nipponicus* and *Callitriche palustris*. At the northern foot of Mt. Fuji, there are five dammed lakes formed by the lava flows from volcanic eruptions. The main constituent species of aquatic vegetation are submerged taxa such as *Hydrilla verticillata* and *Vallisneria natans*. Flora is rich in the two shallow lakes with average water depth of <10 m. The springs and the lakes have been influenced by land use changes of surrounding areas, including agricultural development, tourism, water pollution and shore line modification. Studies on aquatic flora and vegetation of the lakes have shown the decrease of native species and the increase of alien *Elodea nuttallii*.

There was once a large wetland named Ukishima-numa (floating-island-swamp) at the southern foot of the mountain. Artists in the 19th century recorded reed swamp, ponds, peasants, fishermen and tourists at that time. Development of rice paddies began in the 17th century. Flood prevention and drainage works were conducted from the latter half of the 19th century to the first half of the 20th century. In the 1960s, the wetland was turned to rice fields for mechanized farming. Still now Ukishima area is changing because of residential, commercial and industrial development. A flora book published in 1984 recorded 48 aquatic macrophytes from Ukishima, but nearly half of them have disappeared. Ukishima-numa has been affected by the strongest anthropogenic effects among the wetlands at the foot of Mt. Fuji.

Human activities are causing negative effects on the wetlands and their vegetation such as water pollution, wetland loss and invasion of alien species. Meanwhile vegetation control is occurring through conservation activities at several places. Therefore aquatic vegetation and its habitats at the foot of Mt. Fuji are changing under the anthropogenic influences even now.

Poster B62

Small-scale spatial pattern in alpine meadow vegetation with high species richness on the Tibet-Qinghai Plateau

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The Qinghai-Tibet Plateau reaches altitudes of 3000–5000 m and the winter climate is characterised by severe cold. During the short summers, farmers graze yaks and sheep in mountainous area far from their residences, whereas during the long winters, the livestock graze on dead plants in small winter grazing pastures around the farmers' residences. We surveyed vegetation to estimate the small-scale species richness and spatial pattern of species near the Haibei Alpine Meadow Ecosystem Research Station (37°29′–27°45′N, 101°12′–101°23′E, 3200 m a.s.l.) in the summers of 2002–2003. Survey sites were located in (1) two winter grazing pastures (WGP) and (2) a common pasture (CP), where farmers without pastures graze animals year-round. The sites were within 1 km of one another. In 2002, 80 × 0.01-m² quadrats were established along two 8-m lines in the WGP and one 8-m line in the CP. In 2003, 100 × 0.01-m² quadrats were arranged every 50 cm along one 100-m line each in the WGP and CP. We recorded the species numbers for each quadrat and applied the power law and a frequency distribution model for species numbers when analysing quadrat sizes of 0.01, 0.02, …, 0.1 m² by combining adjacent 0.01-m² quadrats.

Common species were *Festuca ovina*, *Stipa aliena*, *Elymus nutans* and *Kobresia humilis*. The mean species richness was >19 in the WGP and 15–16 (0.01 m²)–1 in the CP. In the WGP, all dead plants are consumed in winter. Therefore, even minor species easily colonise exhausted areas in spring, maintaining high species richness. Conversely, since even minor species are eaten in the CP during summer, the species richness is lower compared to that in the WGP. Spatially, for both the 0.01 and 0.02-m² quadrats, the WGP showed greater heterogeneity in species richness than the CP in both years and the spatial heterogeneity in species richness increased with quadrat size and mean richness in both pastures. The small-scale spatial heterogeneity in species composition increased with small-scale species richness and decreased with increasing quadrat size.

Assembly rules among clonal helophytes in South African peatlands: dealing with spatial autocorrelation

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Two South African peatlands, Wakkerstroom and Mfabeni, that have a similar functional composition, have been sampled in five transects and plant composition has been determined for every 25 × 25cm plot. All common plant species in these transects have been analyzed for 17 functional traits. Cluster analysis was carried out on these 17 traits and assisted in subdividing the plants into functional groups. Four functional groups dominate these two peatlands, namely, annual graminoids, leafless graminoids, stoloniferous graminoids and rhizomatous graminoids. Detecting patterns in the plant species composition tied to ecological assembly rules faces the difficulty of disentangling spatial autocorrelation from the effects of ecological selection. This was dealt with by calculating the effective sample size for every species by means of a deflation factor dependent on the Moran's I index for spatial autocorrelation for every species. A null model was built by randomizing species occurrences over a transect with a number that is equal to the effective sample size. The trend is for rhizomatous graminoids and leafless graminoids to attract each other so for the main part, helophyte assemblages are mixtures of intertwining rhizomatous species that follow a 'guerilla strategy' of sending in rhizomes into a dense community that produces shoots within the existing matrix. The occurrence of stoloniferous graminoids or annual graminoids seems not to have a real influence on community assembly.

Species-productivity relationship in plants: where are we (and why not there yet)?

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The relationship between environmental productivity and the number of species [species richness–productivity relationship (SRPR)] has been thoroughly studied, but the mechanisms responsible for its form are still largely unknown. This can be partly due to the scale-dependency of the SRPR. At the continental to global scale, a positive relationship prevails whereas at small spatial scales, observed trends in the SRPR differ. Nevertheless, this scale-dependency may simply result from the fact that large scale studies use different surrogates of productivity than small-scale studies that are based on the measured biomass production.

We tested multiple predictions of the major hypotheses explaining the variation in species richness along a productivity gradient using small-scale herbaceous plot data located in the Czech Republic, and large-scale forest plot data distributed globally. We explored the relative performance of different sets of environmental variables and controlled for effect of the number of individuals using the Rarefaction method.

The SRPR was scale-dependent. At small spatial scale, we did not find any evidence for the universal species-productivity relationship. The SRPR was driven by multiple scale-dependent mechanisms, not necessarily related to the resource level. This highlights the importance of considering the joint effect of different factors in explaining species richness patterns at this scale rather than focusing on the sole effect of productivity. At large spatial scale, the form of the global SRPR highly varied with the productivity surrogate we used. The number of species increased with productivity at this scale only when the productivity estimate was temperature-dependent. Based on the literature review, we further showed that commonly used global productivity models are not necessarily related to the field productivity measurements. We argue that to study the global SRPR, we first need to better understand the global productivity pattern.

Poster D143

Vegetation succession on calcareous grasslands in NE Croatia

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The Slavonian mountains (NE Croatia), situated on the border of the Pannonian and Illyrian floristic area, as well as on the transition area of different climate influences (alpine, dinaric and pannonian), are very rich in diverse landscapes. Most specific semi-natural habitats, which exist on limestone and marlstone bedrocks in this region, are calcareous grasslands. However, these species-rich and rare grasslands are mostly affected by the common problem of land-use change in Croatia. A decline in traditional agricultural practices leads to the abandonment of such habitats which are losing their race against the surrounding vegetation. Since forests are the most common natural habitats in this region, calcareous grasslands are overgrowing with forest vegetation with time, which results in decrease of bio- and landscape diversity. Currently, such habitats are characterized by the absence of any human activity in terms of conservation as well as in terms of any type of planned and systematic management. The successional processes and their impact on biodiversity of inland were explored using the method of chronosequences and the analysis of ecological indicator values and plant functional traits. Floristic changes through five succession stages distinguished by Twinspan were analyzed. Most environmental factors significantly alter during the progression of succession. The most significant changes were observed in the increasing humidity and nutrients values of the habitat, on the other side in the decline of the EIV for light, temperature, pH and continentality.

Plant functional traits show a high correlation to the successional pathway. A significant decrease of hemicryptophytes and an increase of macrophanerophytes have been noticed during the succession progress. Also a significant increased in European floristic elements at the expense of Eurasian and cosmopolitan plants have been observed. In the later stages of succession species begin to flower earlier and have a shorter flowering duration. It also leads to a significant increase in diaspore and germinule weight compared to earlier stages.

Secondary succession causes major changes in species composition, structural characteristics and ecological and functional features of plants and habitats on which they grow. The aim of new insights on floristic, structural and environmental changes in the succession process is to serve as useful guideline for effective management planning of such habitats in Croatia and beyond.

Poster B76

Pollination-related changes in plant functional diversity in abandoned semi-natural grasslands

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Studies on the assembly of plant communities have largely focused on the role of abiotic factors. Biotic factors, such as pollinators, have received considerably less attention. The abandonment of semi-natural grasslands provides a good model system to study the role of pollination in community assembly as the succession following the abandonment leads to a gradual formation of a forest plant community. We studied changes in plant functional diversity in abandoned semi-natural grasslands by comparing the plant communities from a beginning stage and a late stage of succession using 28 site pairs on the islands of Saaremaa and Muhu, Western Estonia. We tested whether traits related to pollination, reproduction, and life history are related to the stage of succession, accounting also for the phylogenetic and spatial relationships among the species and sites. The results show that traits related to pollination are distributed according to a succession gradient, indicating that the interaction with pollinators may play an important role in the assembly of flowering plant communities.

Poster E188

A role of ponds management for plant diversity in an agricultural landscape, Korea

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South Korea is the composition of many agricultural ponds due to irregular rainfall patterns. It`s classified as wetlands by Ramsar convention. The function of the pond is Bio-diversity, flood control, treatment, etc. and is being evaluated as a biotope with unique environmental characteristics. But recently, due to the modernization of the repair facility utilization functions were unnecessarily. Therefore, in this study, to propose appropriate management measures to understand the relationship between environment and vegetation diversity and growth within the agricultural landscape ponds.

Vegetations of total 230 taxa including 73 families, 176 genuses, 199 species, 29 varieties, 1 forma, 1 subspecies were found in the surveyed area. Major species of hydrophytes were *Gramineae* and *Compositae* and *Leguminosae* and *Cyperaceae*. The most frequent growth type forms were annual plant, and growth types were classified by the height of dormant bud, and ratio of hydrophytes was low. Naturalized plants appeared less in wetland than mountainous area, and used land showed higher level than unused land, and land closed to a road showed higher level than land without a road nearby, which showed existence of humans help raise naturalization rate.

Dominant naturalized species in palustrine wetland were *Erigeron annuus*, *Amorpha fruticosa*, *Dactylis glomerata*, *Festuca arundinacea*, *Eragrostis curvula*, *Trifolium repens*, *Erigeron canadensis*, *Ambrosia trifida*, *Oenothera odorata*, *Bidens frondosa*, and plant coverage of *Erigeron annuus* reduced in September. *Amorpha fruticosa*, *Ambrosia trifida*, *Bidens frondosa* eliminate native plants and block flow of water and damage wetland, and therefore, they should be removed in an appropriate period. Ambrosia trifida disturbs eco-system by damaging native plants, and its pollen is harmful to humans, so its colonies should be reduced by removing buds in spring.

Poster D105

Fluctuating asymmetry in plants along steep and subtle environmental gradients – the role of biotic interactions

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Fluctuating asymmetry (FA), the random, nondirectional deviations form perfect bilaterally symmetrical morphological structures, is the most commonly used estimate of developmental instability (DI). Previous studies have shown that FA variance of populations and absolute FA values of individuals increases with cumulative stress. However, most previous studies apply to man-made influences such as pollution, poison, electricity, radiation and natural stressors were hardly investigated. Furthermore, the majority of studies were conducted on animals and the degree to which FA is an indicator of stress also in plants, is still largely unknown. We have conducted a systematic observational and experimental study along three different stress gradients and present here the findings from one of them, a nutrient gradient represented by different grasslands in the Swabian Alb, Germany. Our study had two aims: 1) To establish whether FA can be detected in several different plant species and b) whether FA can be related to different stress levels. We measure symmetry in leaves of six different plant species from six different grasslands with very low to saturated nutrient levels by comparing, as a first proxy, the log transformed ratio between leaf area left (L) and right (R) of the central vein ln (Ri/Li). The levels of FA did not differ systematically along the gradient. We conclude that plants growing in more stressful habitats are adapted to the lack of nutrients and therefore they do not show greater FA values which is likely constituted in a higher developmental stability.

Poster D106

Initial plant population dynamics after coppice restoration in the Czech Republic

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Coppicing was widespread across Europe for many centuries, but during the last 150 years, it has been largely abandoned. Most of the former coppices have been converted to high forest, especially in Central and north-western Europe. Recently, there has been renewed interest in restoring coppices in some regions, primarily for biomass production and nature conservation. However, there is only limited empirical information on the effects of the restoration on plant population dynamics.

To address this gap, two 4 ha experimental plots were set up in the south-east of the Czech Republic where 70-90 years old high forest stands were converted into coppice. Prior to the conversion (i.e. harvest) positions and parameters of all trees with DBH > 7 cm (5105 individuals in total) were measured using FieldMap technology, and the herb vegetation was studied at 20 × 20 m sub-plots.

Since the first year after the harvest, sprouts have been counted and 5 biggest sprouts within each individual measured on a subset of stumps every year. Three year after the conversion, all stumps were revisited to check whether they had successfully resprouted or not. The phytosociological relevés have been done in the vegetation sub-plots every year in spring and summer.

The results showed that most of the cut trees resprouted and have been growing very fast compared to generative regeneration. The rare species that do not almost regenerate in high forest such as *Sorbus torminalis* (L.) Crantz. and *Cornus mas* L. regrew very well and their relative abundances increased significantly.

The diversity of herbs increased by 300% in the first year after coppice restoration but after 3 years started decreasing. The composition changed significantly too with an increase in abundances of endangered as well as invasive species.

Our results show that conversion of high forest to coppice in central Europe may boost plant diversity and help restore habitat for rare or endangered species.

Resilience of semi-natural grassland: summer drought alters fine-scale diversity-invasibility relationship

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Opportunities for plant invasion seem to be better after drought as the stressed or damaged resident community may offer more light and unexploited nutrients to invader species. We ask how extreme droughts affect the resident plants, and whether community invasibility might be increased after drought in semi-natural hay meadows.

In a field experiment with seven blocks of 9 m² we crossed the factors late-summer and spring drought in 2 × 2 quadratic plots. We reduced rainwater at the level of blocks by means of automated rain shelters to simulate 30-yr extreme events and we controlled for drought by regularly adding rainwater to simulate normal conditions at the level of plots. Within plots, we added a mix of ten invader species, with traits matching those of the local community, to one out of two subplots (8 × 100 cm² with grid cells of 4 × 4 cm, each receiving one seed per species) while the second subplots served as a control. Before drought treatments were started in summer, we recorded species frequency in all 56 subplots and repeated these measurements annually for 3 years following the drought treatments.

We separately recorded established plants and recruits, in 200 grid cells of 2 × 2 cm of each subplot. We harvested community phytomass of the subplots at normal dates of haymaking.

Rainwater reduction in summer or spring desiccated the upper soil layer down to <-400 kPa and reduced community phytomass of the next harvests by 40% (September) and 23% (June), but showed no effects beyond that. Frequency data showed low drought-induced mortality of established resident species and graminoid and forb guilds were not affected by droughts. Community invasibility was not affected by late summer drought, as positive drought effects on graminoid invaders and negative drought effects on forb invaders were balanced. Surprisingly, invasibility was positively related to small-scale species richness across control plots while the diversity-invasibility relationship was neutral across plots of the summer-drought treatment. Graminoid and forb invaders showed consistent positive or neutral diversity-invasibility relationships across control or drought-treatment plots.

High persistence of resident species and unchanged invasibility both contributed to community stabilization after extreme drought. The dissolution of the diversity-related recruitment pattern points to a mechanism by which drought inactivates soil pathogens or beneficial specialist arbuscular mycorrhizal fungi, the former favouring recruitment in less diverse, the latter hampering recruitment in more diverse resident-plant neighbourhoods.

Plant species composition in the fast-flowing streams of Peninsular Thailand

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The stream ecosystems of the tropical regions are one of the most unexplored areas, especially in Peninsular Thailand where two bio-geographical regions overlap: Continental south-east Asian and the Malesian region. This study was conducted with an interest to record the diversity of the plant species in and along fast-flowing streams of Peninsular Thailand. The study was carried out from November 2010 until May 2012, on the two most common types of the bedrock in peninsula i.e. granitic and calcareous. A total number of 109 species had been recorded, which belong to 75 genera and 49 families. The diversity on the two types of the bedrock streams differed significantly with 10 species in common. The most common species along granitic bedrock streams are herbs and shrubs e.g. *Ficus ischnopoda* Miq., *Cephalomanes javanicum* (Blume) C.Presl., *Bolbitis heteroclita* (C.Presl.) Ching ex C.Chr. etc; while in calcareous bedrock streams tree species are dominant e.g. *Saraca indica* L., *Elaeocarpus grandiflorus* Sm. etc. Each type of the bedrock streams accommodated specific microhabitats with particular set of the plant species, which produced different patterns of plant distribution in granitic and calcareous bedrock streams. In general, four types of microhabitat had been recognized: rocky areas, stream banks, stream floor and shallow pools. This research gave the essential information on basic knowledge concerning diversity of the tropical stream ecosystems in Peninsular Thailand that would be useful for the further investigations on the vegetation survey of such habitats.

Seed heteromorphism of *Epipactis helleborine* (L.) Crantz *(Orchidaceae)* in heterogeneous habitats in Poland

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Backgraund We quantified the morphological differences in seed morphological traits between and within different populations of *E. helleborine* and we correlate these variations with local environmental conditions. Objectives Study sites were located in three different regions along a latitudinal gradient of 1000 km from northern to southern Poland; from the Białowieża Primeval Forest, NE Poland (4 populations), Central Poland (2 populations), Lower Silesia, SW Poland (2 populations). Eight populations of *E. helleborine* taken from natural habitats such as peat, conifer forest or deciduous forest, and human disturbance habitats, such as roads, in Poland were investigated to determine the pattern of seed and embryo variation.

Methods We collected seeds of *E. helleborine* from each of the populations at the end of the summer, September 2011, and weighed them. Dehiscent capsules (three per individual plant) were collected from several, widely spaced individuals in all populations (n=30 sampled individuals per population). This procedure increased the probability of broadly sampling genetic diversity within populations. Mature seeds (30 per capsules) were taken from live plants from 3 dehisced of capsules from the same individual (n = 30 × 3 × 30). We measured the following morphological and anatomical traits of seed: i) seed length, ii) seed width , iii) seed circuit , iv) seed area, v) embryo length, vi) embryo width, vii) embryo circuit, and viii) embryo area. We also calculated the volume of seeds, volume of embryos and percent of free air space in the test. To document edaphic differences among sites, soil texture and chemistry were analyzed.

Results Morphological traits of *E. helleborine* seeds varied significantly among populations and individual shoots but did not differ among regions. The statistically significant differences in almost all studied characters were found between the plants from natural habitats and human disturbance habitats. Data on the seed and volume show that higher seed volume is the result of both greater length and width. This species showed important differences in seed traits, some of which seem to correspond to the different habitats.

Conclusion Morphological traits of *E. helleborine* seeds removal varied significantly among populations, but there were no consistent differences among the regions studied. This study of seed trait differences may contribute to our understanding of optimum habitat conditions and the ecophysiological adaptations of plants.

Monitoring habitat types with multiseasonal remote sensing and MaxEnt

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Monitoring of vegetation types becomes increasingly important due to global change and ongoing intensification of agricultural land-use systems. Programs of international interest like the Natura2000 project (European Union Habitat directive) or the High Nature Value Farmland (EU rural policy framework) demand an immense effort of mapping vegetation. Remote sensing offers a great potential for conservation monitoring.

In our study we use high resolution satellite data and field data to be able to map the distribution of several habitat types continuously over a broad area. Variations in the appearance of the very same vegetation type at different places and times are taken into account by including phenological information. Therefore we work with multiseasonal, multispectral satellite images (RapidEye), and reference areas with their respective, current reflectance instead of spectral libraries that have been previously used for this task. The Maximum Entropy (MaxEnt) algorithm, often used in macroecology, has a great potential for identifying individual vegetation types in a matrix of complex vegetation patterns. The field campaign took place in Bavaria, Southern Germany, in early summer 2011 and 2012. We have sampled 186 plots concerning the vegetation belonging to four different vegetation types according to the European Habitat Directive (Molinia meadows, degraded raised bogs, transition mires and quaking bogs, alkaline fens), or to High Nature Value Farmland (five quality-classes). For each plot cover fractions of all dominant occurring vascular plants and mosses were estimated and the plots were classified. Information on the surface reflectance is available from the RapidEye sensor in 5 spectral bands (5m spatial resolution). We used MaxEnt to relate the point based habitat type information to the corresponding reflectance. The final output consists of maps of occurring classes and measures of uncertainty. These maps will support an assessment of habitat distribution at regional scales and make future monitoring more time and cost efficient.

From desert to Mediterranean rangelands: Will increasing drought and inter-annual rainfall variability affect herbaceous annual primary productivity?

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Climate change is predicted to alter the rainfall regime in the Eastern Mediterranean Basin: total annual rainfall will decrease, while seasonal and inter-annual variation in rainfall will increase. Such changes in the rainfall regime could potentially lead to large- scale changes in aboveground net primary productivity (ANPP) in the region. We conducted a data-driven evaluation of herbaceous ANPP along an entire regional rainfall gradient, from desert (90 mm MAR [Mean Annual Rainfall]) to Mesic-Mediterranean (780 mm MAR) ecosystems, using the largest database ever collated for herbaceous ANPP in Israel, with the aim of predicting consequences of climate change for rangeland productivity. Moreover, we collected long-term data on species richness along the aridity gradient considered. This research revealed that herbaceous ANPP increases with increasing rainfall along the gradient, but strong dependence on rainfall was only apparent within dry sites. Rain Use Efficiency peaks at mid-gradient, in mesic Mediterranean sites without woody vegetation (560 and 610 mm MAR). Inter-annual coefficients of variation in rainfall and herbaceous ANPP decrease along the rainfall gradient up to ca. 500 mm MAR. Climate change is more likely to affect herbaceous ANPP of rangelands in the arid end of the rainfall gradient, requiring adaptation of rangeland management, while ANPP of rangelands in more mesic ecosystems is less responsive to variation in rainfall. Species richness increased at the arid and semiarid sites, but no clear relationship was found at the mesic sites. We conclude that herbaceous ANPP in semi-arid and mesic Mediterranean rangelands is less vulnerable to climate change than generally predicted. Further considerations about species richness and ANPP along aridity gradients will be presented and discussed.

Patterns and processes of long-term spatial dynamics of plant communities: a case study on the Holocene changes in landscape-scale vegetation mosaic in SE Estonia

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Although regional vegetation is mostly controlled by climate variables, plant ecologists observe, and often assume, that a spatial mosaic of soils and topography is one of the important factors for the spatial structure of plant communities and species distribution at local- to landscape-scales (<106 – 107 m^2). However, the Holocene spatial dynamics of vegetation in those scales is rarely known in Estonia and elsewhere. This study aims to evaluate the extent to which the spatial pattern of soils and topography affects the spatiotemporal dynamics of vegetation and land cover in the Holocene at the Haanja Nature Park, a ca. 60-km^2 reserve in southeastern Estonia.

For reconstruction of the past vegetation at the landscape scale, we use the Landscape Reconstruction Algorithm (LRA) (Sugita 2007a,b; Sugita et al. 2010); this model-based approach is first to estimate regional vegetation using fossil pollen records from lakes >50-100 ha and second to reconstruct local vegetation using fossil pollen from smaller sites by taking into account long-distance pollen coming from the regional vegetation. In addition the inverse modelling of the LRA is applied to evaluate indirectly the changes in vegetation mosaic based on the changes in the relevant source area of pollen (RSAP; sensu Sugita 1994); if topography and soils were the primary cause of the vegetation mosaic, the RSAP is expected to be constant. The Haanja area is ideal for an application of the LRA approach, because pollen records are available from many forest hollows, which are small depressions 5 – 15 meters in diameter in forests, and several medium-sized lakes. Four lakes and thirteen forest hollows are selected for this project.

Sediment accumulation starts ca. 11,000 – 10,000 years ago at most sites. However, we find that most hollows have hiatuses in sediment between ca. 6000 and 1000 years ago; accordingly pollen records from the first half of the Holocene and the most recent millennium are used for the LRA-based reconstruction. Preliminary findings are: (1) the vegetation composition within the RSAP differs significantly between hollow sites and (2) the RSAP increases gradually and consistently from 11,000 to 6000 years ago but is relatively low over the last millennium. All the results suggest that the spatial pattern of the vegetation mosaic changes though time at Haanja. Thus other factors, including the changes in vegetation composition, direct and indirect impacts of human activities, and local changes in ecosystem dynamics, appear important for the long-term spatial dynamics of vegetation at the landscape-scale.

Large scale comparison of species composition of steppe from northwestern China to eastern Mongolia

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The Eurasian steppe extends as a broad belt across the continent from Hungary to northeastern China (Archibold 1995). The steppe is commonly characterized by predominance of the genus *Agropyron*, *Cleistogenes*, *Festuca*, *Helictotrichon*, *Koeleria* and *Stipa* (Lavrenko and Karamysheva 1993). However, the species composition is different among regions because climatic, topographical and palaeo-environmental factors are different. Actually, various communities were classified in each region (Hilbig 2000; Ermakov 2012). Now, there is a question that how does the steppe communities transition along longitudinal variation. Although latitudinal and altitudinal transitions are drastic (Lavrenko and Karamysheva 1993; Hilbig 2003; Zemmrich et al. 2010), longitudinal transitions seem to be gradual. Hence, the pattern of longitudinal transitions could be distinctive from that of latitudinal and altitudinal transitions. In this study, we aimed to clarify the pattern of longitudinal transitions of species composition of steppe. This study was done by the large scale comparison which ranged about 2500 km in east-west direction, from northwestern China to eastern Mongolia.

We have recorded the species composition of the steppe in northern Xinjiang, China in 2009, mid Mongolia in 2010, western Mongolia in 2010 and 2011, and eastern Mongolia in 2012, by using the phytosociological methods of Braun-Blanquet (1964). Using these vegetation descriptions, plant communities were classified by phytosociological table work in each region (Muller-Dombois and Ellenberg 1974). After that, constancy table which contained all regions was formed. All regions of Mongolia had a lot of common high constancy species, for example, *Agropyron cristatum*, *Artemisia frigida*, and *Caragana pygmaea*. These were the diagnostic species of steppe and meadow steppe in Mongolia. We can say that the species composition of Mongolian steppe has affinities among all regions. However, the species composition was considerably different between Xinjiang and Mongolia. The Altai Mountains are lain between Xinjiang and Mongolia, and the Mountains seem to hinder the species run between Xinjiang and Mongolia. As for longitudinal transitions, topographical factor could be the main driver.

Mongolian steppe was subdivided into western Mongolia and others. Western Mongolian steppe was characterized by *Gypsophila desertorum* and *Stipa glareosa*, which were the diagnostic species of desert-steppe. Mid Mongolian and eastern Mongolian steppe was characterized by *Leymus chinensis*, *Serratula centauroides*, which were the diagnostic species of steppe and meadow steppe, and so on. Thus, we can say that species composition transitioned by turnover of components of desert-steppe and those of steppe and meadow steppe in Mongolian steppe.

Weed diversity on the background of spatial patterns of agricultural landscape in western Poland

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The intensification of agriculture such as: fertilization, mechanization and chemical weed control, are universally recognized causes for decline of plant diversity in arable areas. Agricultural landscapes reflect the long-term interactions between natural environment and human pressure. Therefore species composition of segetal flora is simultaneously influenced by various environmental factors as well as by such management as: application of herbicides and fertilizers or time of sowing and ploughing. As result of these practices, some weed species, especially with narrow ecological amplitude may disappear. Specific disturbance regime and habitat conditions affect plant cover. Fields as constantly disturbed habitats provide niches mainly for annual plants with short life span.

The aim of these studies was to examine species diversity on the background of landscape patterns, habitat conditions and disturbance regime.

The study area was located in Lubusz region (Western Poland). There were chosen 33 villages with differentially preserved structure of surrounding fields, where in the arable areas were located 145 plots of 50 m² each, according to the stratified sampling scheme. These plots were distributed in the 200 m buffer zone of built-up areas in two different types of landscape structures, that is in small fields adjacent to the village and in the farther situated fields of different size. Information concerning field size were overlaid in vector format in the GIS on the basis of aerial photographs and cadastral maps. Habitat fertility was estimated on the basis of Ellenberg indictor values (EIV). Species richness was measured by Shannon diversity index and Shannon evenness was used as a measure of equitability. In each plot the type of plant community was defined and flora was analysed in terms of plant functional traits. Following characteristics were included: Life span (annuals, perennials), seasonality (emerging in spring and summer), life strategy, life form and residence for alien species. Additionally, the diagnostic value of each species and its degree of threat were analysed. To identify the relationship between habitat and species traits correspondence analysis and logistic regression were used.

Are bryophyte communities on island biotopes determined by environmental factors or by dispersal limitation of the species?

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Bryophytes are usually considered as dispersal unlimited due to their small wind-spreading diaspores. The main objective of this study is to find out relative influence of dispersal limitation and environmental factors on community assembly of bryophytes on island-like mountain spring biotopes.

Our study was conducted in the Jeseníky Mountains, NE Czech Republic, where species composition and important environmental factors were sampled in 66 springs divided in two groups: subalpine and forest springs. Partial Mantel tests were calculated for three matrices based on dissimilarity in species composition, geographical position of sites and measured environmental factors.

While the forest springs showed significant correlation between species composition and both geographical distance of sites and environmental factors, in case of subalpine springs there is no significant relationship between species composition and either group of factors.

The factor responsible for dispersal limitation in forest sites could be the presence of trees representig natural bariers for dispersion of diaspores. There is also higher variability in some environmental factors (water conductivity, elevation and slope orientation) which probably causes differences in species composition between sites. On the other hand subalpine springs are homogeneous in terms of environmental factors and more spatially connected and therefore species are more randomly distributed.

Comparing statistical and dynamic model projections for European trees

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Climate change has been predicted to cause extinctions and range shifts in European flora. Two common methodologies assessing climate impact on vegetation are statistical species distribution models (SDMs) and process-based dynamic vegetation models (DVMs). SDMs are relatively easy to implement, but do not account for factors other than climate influencing species distributions. DVMs can be considered biologically more sound, combining detailed representations of population dynamics with mechanistic representations of plant physiological processes and considerations of species interactions. They, however, require detailed data, including climate, atmospheric CO_2 concentration, soil texture class, and species traits.

We test whether these two modelling approaches produce similar projections for five common European tree species (Pedunculate Oak, Common Hazel, European Beech, Scots Pine and Norway Spruce) for the period 2050 and 2080, based on emission scenario SRES A2 and global circulation model HadCM3. We question whether differences are mostly due to a) the present-time occurrence data that SDMs are fit to or b) processes accounted for only by the DVMs. We obtained DVM projections for present and for the future. We fitted SDMs separately to either atlas-data and to expected present occurrences as predicted by DVM. We then produce projections for the future with either sets of SDMs or directly with DVMs.

Future projections obtained with SDMs fitted to atlas data differed largely from those obtained with DVMs. The agreement of predictions was highest in North and Northwest Europe, and lowest in Mediterranean area, for which SDMs predicted large contractions. DVMs predicted presence south to observed (Atlas) ranges, in areas that presently lack the species possibly due to anthropogenic impact. Differences between future projections were reduced when the comparison was done to SDMs fitted to potential present data instead of atlas data - with now SDMs showing only moderate range contractions for northern conifers. These findings would indicate that both approaches are able to capture the important associations between vegetation and climate that drive species distributions at these large scales. Our results, though, urge for caution in using atlas data as input for SDMs if this data does not fully reflect the current potential distribution of species, as it may happen in highly anthropogenized regions. Nonetheless, late successional species appeared to have the largest disagreement between models, calling for further investigation of the role of species interactions in determining future distributions.

Is productivity or spatial heterogeneity determining small-scale plant species richness? Contrasts between temperate and tropical regions

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Understanding mechanisms driving plant species richness is one of the main research areas in ecology. Both productivity and environmental heterogeneity are deemed important in driving richness patterns, and have been long studied in ecology. Firstly, the productivity-diversity relationship (PDR) is generally considered to be unimodal, with highest richness at intermediate productivity. Secondly, the heterogeneity-diversity relationship (HDR) is traditionally expected to be positive due to niche differentiation and avoidance of competitive exclusion. However, recent studies have found that these relationships are not universal. The aim of this study is to determine the relative importance of productivity and heterogeneity in explaining species richness patterns in temperate and tropical regions. We use data from the Nutrient Network (a coordinated research network sampling grasslands worldwide) to study the PDR and HDR in regions of contrasting climate and evolutionary history. We included 56 grassland sites from around the world, using data on species richness (1 m^2 scales), productivity (measured as above-ground biomass in 1 m^2) and spatial heterogeneity (measured as the coefficient of variation in above-ground biomass). We use linear mixed effects models for temperate and tropical datasets to determine the most important factors driving species richness patterns. In temperate regions, productivity was more important than heterogeneity in explaining plant species richness and exhibited a unimodal PDR. However, in tropical regions, heterogeneity had a greater role in explaining plant richness, and this relationship was negative, in contrast to the commonly assumed positive HDR. Additionally, the PDR was positive in tropical regions, inconsistent with the expected unimodal relationship. The relative importance of productivity or heterogeneity in explaining species richness patterns varies in regions of contrasting climate and evolutionary history. Our findings are consistent with a meta-analysis reporting a positive PDR in the tropics and unimodal PDR in temperate regions, as well as with meta-analyses showing a negative HDR due to a higher level of competition in heterogeneous conditions. The contrasting results in temperate and tropical regions may be due to evolutionary histories of species and niche conservatism.

Poster A18

Estimating changes of two *Fagus* species populations from the past to the future, based on the inventory of a 404-ha monitoring plot under a marginal climatic condition for *F. crenata*

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Fagus crenata is a dominant species of late-successional forests in the cool-temperate zone of Japan. Shift and shrink of potential habitats for the *F. Crenata* forest were predicted by species distribution models, SDMs (Matusi et al. 2004, Tanaka et al. 2006). *F. crenata* populations on low mountains in western Japan and Pacific side of Honshu were predicted to be vulnerable to climate warming. In order to clarify the current pattern of *F. crenata* population as well as to detect its future changes in comparison with *F. japonica*, a mid-temperate species, we established a 404-ha monitoring plot covering the *F. crenata* forest above 500m a.s.l. on Mt. Tsukuba (876 m), which was predicted to be vulnerable. There are preserved old-growth forests on the southern slope and secondary forests on the northern slope. All individuals higher than 2 m for two species were leveled and recorded by position (latitude and longitude) and stem diameter. Using classification tree models (CTMs), individual distributions were predicted by seven explanatory variables, i.e., warmth index (WI), topographic wetness index, radiation, inclination, curvature, land owner and past land-use in 1948.

The number of individuals was 7,073 for *F. crenata* and 1,649 for *F. japonica*. Diameter distributions of *F. crenata* showed limited number of individuals smaller than 10 cm, indicating the poor regeneration. The map of individuals showed a few patchy distributions of the small ones. However, small individuals and sprouts of *F. japonica* were many, indicating sound regeneration. According to the CTMs, the importance of variables was in an order of WI > past land-use > land owner > radiation for *F. crenata* while WI > past land-use > radiation > inclination for *F. japonica*. The majority of *F. crenata* individuals was located on the areas with WI<85.8 and of the deciduous forest and mixed forest in 1948 while that of *F. japonica* ones was located on the areas with WI<87.6 and of the deciduous forest and non-forest in 1948. This means that the current individual distributions of two species have been mainly influenced by temperature and past land-use.

In accordance with the vulnerability prediction by SDMs, we confirmed the declining *F. crenata* population on this mountain. Because WI is the main controlling variable, warming climate would facilitate the decline of the *F. crenata* population from the past to the future. To conserve the *F. crenata* population on this mountain, the active management including planting is necessary.

Processes responding to restoration of oligotrophic pine fens

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Growing public interest in safeguarding peatland biodiversity and to increase the capacity of peatlands to retain atmospheric carbon has created a need for peatland restoration. In Finland, restoration is mainly practiced in drained peatlands located in or near protected areas. Other prominent sites for restoration are peatland forests where drainage has failed to improve growth of the tree stand. Restoration of peatland forests is a relatively recent management option, and few studies have been carried out in regard to peat forming processes and restoration-driven plant succession. Vegetation and hydrological indicators are commonly assessed to indicate restoration success, but changes in mineralization and decomposition rates might better indicate when peat formation is underway in restored peatlands.

We studied how restoration affects the peat forming processes and understorey vegetation of oligotrophic pine fens located in conservation areas in Kainuu, eastern Finland. The drainage had resulted in the higher peat nutrient concentrations as compared to pristine fens. All fens had a relatively similar vegetation composition, and there were no clear separation between pristine and managed fens. The managed fens, which had been drained for forestry during the 1970s and 1980s, were restored in 2007 by blocking and damming the ditches. Two tree harvest methods were used: stems only and whole tree harvest. We investigated the changes in plant species richness and cover after peatland restoration, and mineralization and decomposition processes in the upper peat layer separately before and after actions.

After restoration, mineralization and decomposition processes were similar for the pristine and restored fens, except near ditches after stem harvest with higher net N mineralization rate. According to our results, mineralization and decomposition rates are suitable indicators for peat formation after restoration. The plant groups showed somewhat different responses to restoration, but the tree harvest methods did not affect differently the plant species composition or the number of species. In 2012, we observed moss species, typical for hollows, in the blocked ditches indicating restoration-driven plant succession. The differences in the rate of change in species richness and cover of different plant groups will be presented.

Poster C89

Revegetation of disturbed soil surface after energy wood harvest

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In recent years, energy wood harvesting has rapidly increased in Finland. However, we don't know all the impacts of removal of logging residues and stumps on biodiversity, and further on forest regeneration in different types of forests. Generally, growth conditions are strongly changed by actions like stump removal after clear cutting. Stump removal not only takes off the nutrient resource, but also opens large mineral soil patches. Fast-growing species representing early succession stages are expected to occupy these mineral soil patches in forests. We aimed to study the differences in vegetation after stump removal. We hypothesized that 1) stump removal increases disturbed soil surface as compared to patch mounding and logging residue removal, and 2) soil surface exposed to stump removal increases species number, cover and biomass of fast growing herb and grass species, and decreases species number, cover and biomass of slowly growing dwarf shrubs, bryophytes and lichens. The effects of stump removal was studied in Norway spruce-dominated forest stands in Finland. The two southern areas belong to the southern boreal vegetation zone, and the most northern area to the middle boreal vegetation zone. We included four soil preparation treatments to this study: 1) patch mounding, 2) 70% logging residue removal and patch mounding, 3) 70% logging residue removal, partial stump removal and patch mounding, and 4) 100% logging residue removal, stump removal and patch mounding. Nearby forest stands were used as reference treatments. After tree cutting and soil preparation in 2008, we measured proportion of disturbed soil cover at each site. We inventoried understorey vegetation before treatments in 2007. In 2009, vegetation was inventoried from the patch mound and nearby least disturbed soil surface.

The two stump removal treatments affected the soil surface similarly. Stump removal decreased intact soil cover and increased total mineral soil cover more than logging residue removal only as compared to patch mounding treatment. The plant species composition was slightly different between the study areas, but not between the soil preparation treatments. The differences in the rate of change in species richness and cover of different plant groups will be presented separately for areas and treatments.

Modelling of niches of Central European root-hemiparasitic species

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Root-hemiparasites are considered an important functional group of plants due to their ability to affect competitive relationships in plant communities and alter nutrient flows. Specifically, they have ability to suppress strong competitors and facilitate nutrient cycling releasing nutrients which can be used by other co-occurring species. On the basis of these effects, hemiparasite can enhance community diversity and stability. European hemiparasites have been subject to intense research in recent decades focusing on various aspects of their biology, but most of this has been based on mesocosm experiments resulting in a limited relevance for their ecology on the landscape scale. Although several field and modelling studies identified e.g. the response of hemiparasite populations on site productivity, projections of hemiparasite occurrence still heavily rely on expert knowledge of ecological behaviour of individual hemiparasitic species.

Our aim is to model species niches of Central European hemiparasites based on the plant community composition data available in the Czech National Phytosociological Database. Using the formalized vegetation classification of samples included in the stratified version of the database, we identified vegetation units (classes, alliances) within which individual hemiparasites occur. This however provided only a rough shape of species niche since proportion of relevés occupied by a species largely differed among the vegetation units. Therefore, we adopted a Beals index-based approach to refine the niche shape resulting in a classification of relevés into three groups: i. hemiparasite present, ii. hemiparasite is absent but the species composition of the relevé suggests that it is part of its "dark diversity" (based on the Beals index), iii. hemiparasite is absent and is not included in the site species pool. The first two groups of relevés are considered as (at least potentially) suitable sites, i.e. to be within the species niche of the hemiparasite.

For each species, we visualized its niche and environmental gradients within it using non-metric multidimensional scaling. Ellenberg indicator values were projected in the ordination space in order to provide further interpretation and comparison between individual hemiparasitic species. In addition, we used a functional traits-based approach to locate the species beta-niche on trait gradients across the whole vegetation. Finally, null models and analysis of nestedness was used to explore the relationship between occurrence of hemiparasites and plant community diversity.

Factors shaping establishment of a declining orchid species, *Pseudorchis albida*

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Pseudorchis albida is a rare and declining orchid species in Europe despite its typical habitat, nutrient poor mountain grasslands and heaths, is relatively common in some regions. The species is obligately dependent on mycorrhizal symbiosis with basidiomycetes from *Tulasnellaceae* family for both germination and adult stage. We investigated factors which could limit establishment of the species in landscape. We used in situ seed baiting technique and analyzed germination rate at 19 sites recently or historically occupied and sites never occupied by the species. Further, we investigated fungal symbionts in mycorrhizal seedlings and adult plants and also abiotic conditions (pH, total N, total and available P, and organic matter content) at microsites with successful and unsuccessful germination. In spite of high specificity to a narrow monophyletic clade of T*ulasnellaceae*, seeds of *P. albida* germinated at all sites independently of the presence of adult plants to the stage of advanced mycorrhizal seedlings. Suitable mycorrhizal fungi were available at all investigated sites. Beside the mycorrhizal fungi, broad variety of ectomycorrhizal, ericoid mycorrhizal and endophytic fungi was found in the seedlings; however, no difference was found among the sites in this respect. Of the analyzed soil characteristics, only higher pH positively influenced the germination. To summarize, although the decline of *P. albida* could have been caused be changes in land use or acidification of the landscape in the past, recent conditions at the sites are still suitable for its establishment. However, factors affecting the growth beyond the stage of underground mycorrhizal seedlings would deserve further investigation.

Early Holocene vegetation patterns in NE-Germany

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Pollen is the best record available to reconstruct past terrestrial vegetation, but interpreting the pollen record in terms of past plant abundances and vegetation patterns is problematic. Plants differ in pollen productivity and dispersal capabilities of pollen and may thus be over- or underrepresented in the pollen record. Furthermore, pollen spectra from lakes or peatlands include pollen from nearby as well as from distant plants. The later contribute much less pollen to a site, which implies that one and the same pollen spectrum may represent very different vegetation scenarios.

The extended downscaling approach attempts to reconstruct past plant abundances and patterns by using simulations. The method searches for that vegetation scenario that, for a set of sites, results in simulated pollen deposition most similar to empiric pollen deposition. Patterns in the vegetation scenarios are defined by patterns of e.g. soils and relief.

The approach is demonstrated using an example from NE-Germany. It is used to explore whether and what kind of forest communities existed during the early Holocene, whether and where initial populations of temperate woody taxa, e.g. Corylus avellana, existed during that period and how open the vegetation was. The results show that rather than uniform forests rather distinct vegetation types on distinct site types existed and that open vegetation played a significant role during the Early Holocene.

Ribosomal DNA sequence variation in the Arbuscular Mycorrhizal Fungi

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Most molecular ecological studies of arbuscular mycorrhizal fungi (AMF, Glomeromycota) have been based on the rRNA gene sequences. Sequence variation was reported across variable (internal transcribed spacers - ITS) as well as more conserved regions (small ribosomal subunit - SSU/ large ribosomal subunit - LSU) of the rRNA genes and among species belonging to different genera of the Glomeromycota. However, a very few isolates have been sequenced more than once for any marker region. In this project, we aimed at i) testing the resolution power of each marker (SSU, ITS and LSU) at the level of isolates, ii) providing information about intra- vs interspecific sequence variation for accurate AMF species detection and delimitation, iii) providing reference sequence data from the near-full length rDNA operon of two isolates of *Rhizophagus irregularis* and *Gigaspora margarita*. A total of 239 cloned sequences spanning the near full length SSU rRNA gene, the full ITS and *ca* 2000 bp of the LSU rRNA gene were obtained from at least three spores of two isolates of *R. irregularis* and *G. margarita*. Data for each marker region (SSU, ITS and LSU) originated from the very same spores. Sequence variation resulting from point mutations and small indels was recorded in all regions. Overall, highest sequence variation was observed in the ITS region followed by LSU and SSU at both the inter- and intrasporal levels. Interaction term between region and isolate was significant in *R. irregularis*.

Soil pH as a determinant of micro-habitat and plant community diversity on altitudinal gradient

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Soil conditions and especially pH and calcium carbonate content are the most important factors controlling species diversity in many plant communities. While vegetation of acidic soils is relatively uniform, we can determine some level of vegetation patchiness even in micro-habitat scale on places of calcareous habitats. This trend may increase with increasing altitude, which is usually positively related to precipitation and negatively to temperature and evapotranspiration.

A data set of non-forest vegetation sampled on flat planes was selected from the CZ national database. For each plot, species with the highest and lowest Ellenberg indicator value for soil reaction was selected. A range of indicator values for each plot was compared on an altitudinal gradient to determine whether basic stands in higher altitudes are relatively richer in relation to the species pool. Subsequently, soil pH and vegetation was sampled and analyzed in microhabitat scale in several 5 x 5 m plots both on acidic and calcareous stands in different altitudes of the Central Europe.

In Central European conditions, the micro-habitat diversity increase is related to altitude especially on calcareous bedrock, where leaching and acid rains may create locally more patchy stands with rather different soil pH, which may directly or indirectly influence composition of species even on the scale of one plot. It may have some other consequences: A local increase of alpha diversity in decreasing species pool and possibly more dubious classification of plot sampled under these circumstances can be expected.

Alexander von Humboldt award lecture

Biodiversity: From Evolutionary Origins to Ecosystem Functioning

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Numerous lines of evidence support a "Universal Tradeoff Hypothesis," which posits that the same interspecific tradeoffs that lead to speciation also lead to multi-species coexistence, and cause ecosystem functioning to be strongly dependent on biodiversity. For instance, fossil records for mollusks, mammals, trees, and other taxa show that, with rare exception, ecologically similar species have coexisted for a million years or more after interchange between formerly isolated realms. Because competition theory predicts that multispecies coexistence requires that species have traits that fall on the same interspecific trade-off surface, the observed coexistence after interchange suggests that during their speciation and subsequent evolution, all species have consistently been bound to the same interspecific trade-off surface despite different phylogenetic and geographic origins. Moreover, theories of multi-species competition also predict that higher diversity leads to greater ecosystem productivity and greater stability if the competing species can coexist because of interspecific tradeoffs.

The Universal Tradeoff Hypothesis thus has the potential to provide a single unifying explanation for the evolutionary origins of biodiversity, for mechanisms of multi-species coexistence, and for ecosystem processes. In so doing, it strengthens the logical basis for the assertion that the loss of biodiversity, whether from species extinctions, community simplification, or loss of genetic variation within populations, can have serious implications for global environmental sustainability.

Poster B64

Patterns of fine-scale species richness across Bulgarian dry grasslands

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Dry grasslands and steppes are natural or semi-natural ecosystems with considerable beta diversity and high species richness. Some dry grassland types harbour the highest levels of local species richness among all ecosystems of the world. Therefore, in the context of their conservation and management practices, knowing the factors affecting local species richness in steppes is of great importance. Studies from western, central and eastern part of the Eurasian steppe zone suggest that the main candidate factors are primary productivity (as an expression of the availability of resources, mainly water) and pH (a non-resource factor reflecting historical and evolutionary effects on current species pools). Bulgarian dry grasslands are a very suitable model for analysing the patterns of local species richness since they developed under much stronger influence of the submediterranean flora than the steppes in the other regions. Thus, it may be tested whether the patterns recognized in other areas are valid for a flora with different evolutionary history.

Main questions of the present study are: 1) Which are the main abiotic factors that affect local species richness of vascular plants? 2) Are species richness patterns in Bulgarian dry grasslands the same as found in other regions? If not, why?

Our data consist of 172 vegetation plots (10 X 10 m²) collected from dry and semi-dry grasslands across Bulgaria and SE Romania. Species numbers of vascular plants per plot was used as a measure of local species richness. Soil and biomass sample were taken for measuring the content of main plant-available nutrients – nitrogen, phosphorus, calcium, potassium, magnesium (soil and biomass) and organic carbon (soil). Soil depth and biomass weight (separately for graminoids, legumes, forbs and woody parts of perennials) were used as surrogates for water availability. Climatic variables were extracted from WorldClim.

For quantifying relationships between numbers of vascular plants and environmental variables we used correlation and regression analyses, and for more complex relationships – regression trees. The preliminary analyses (nutrients not included) showed that soil pH and soil depth do not have significant effect on local species richness. In contrast, it seems that local species richness mainly depends on macroclimate and associated phytogeographical influences. Dry grasslands in regions of Bulgaria with submediterranean climate (i.e. those with warmer winters and precipitation maximum in the autumn-winter period) are species richer at the local scale.

On the spatial scaling of species composition and diversity in western Amazonian rain forests

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Background
Amazonian rain forests are physiognomically rather uniform at broad spatial scales, so vegetation classification in the area is generally based on hydrology (seasonally inundated, waterlogged, well-drained) and whether the soils consist of white quartzitic sands or not. Obtaining detailed information on species distribution and diversity patterns in Amazonian forests is laborious due to their sheer species richness and the fact that obtaining voucher specimens for later identification necessitates extensive tree climbing. We have circumvented these problems by focusing on understorey plants, especially pteridophytes (ferns and lycophytes) and the family *Melastomataceae* (which consists mostly of shrubs and small trees). These provide models for how species composition and richness patterns vary in space and along edaphic gradients.

Objectives and methods
To document how plant species composition and diversity varies across western Amazonian rain forests from the local to the regional scales, we established four transects that ranged between 23 km and 29 km in length. Two of these were in northern Peru and two in southern Colombia. Each transect was divided into 100-m contiguous subunits. All pteridophytes and *Melastomataceae* species were recorded in each subunit, and surface soil samples were taken at 1-km intervals.

Results and conclusions
We encountered a total of 182 pteridophyte species and 183 *Melastomataceae* species in the four transects, with each transect containing 78–119 pteridophyte species and 77–102 *Melastomataceae* species. Within the 100-m-long subunits, pteridophyte species richness was generally higher than *Melastomataceae* species richness. The species richness patterns of the two plant groups differend both at local and at regional scales. Each transect could be divided into floristically distinct sections, which were often floristically more similar to sections in another transect tens of kilometers away than to adjacent sections in the same transect. However, there were also major differences among the transects, which reflect differentiation of the forests at the regional scale. In general, the floristic patterns were similar between the two plant groups and corresponded to variation in soil properties, especially cation content and texture. Because only one of the transects contained patches of white sand soils, most of the compositional variation was observed within the "typical" rain forest and is therefore not readily observed without detailed floristic inventories. Such hidden spatial diversity has practical implications for conservation planning and species distribution modelling in these forests.

Poster B65

The limitation of diversity in highly productive communities by the example of floodplain meadows (The Ob River, Western Siberia)

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We studied long-term data about productivity of meadow communities, growing on the Ob floodplain in the out-skirts of Surgut. Our aim was to clarify the connection between productivity and diversity, and how this relationship is affected by flooding. Typologically the meadow communities belong to two classes: 1) *Phragmito-Magnocaricetea*, including the associations *Caricetum aquatilis*, *Caricetum gracilis*, *Caricetum distichae*, *Phalaridetum arundinaceae* and *Calamagrostietum purpureae*; 2) *Molinio-Arrhenatheretea*, represented by *Anemonidio-Phalaroidetum* association and its variations. The monodominant *Phragmito-Magnocaricetea* communities of sedges and large graminoids occupy the wide areas, while polydominant forb-grass meadows of *Anemonidio-Phalaroidetum* association are presented locally. The low species diversity is usually explained by long-lasting flooding, so as the polydominant forb-grass communities are located on higher places. Still, we find another reason for prevalence of the low diversity communities. In our study the data were collected in August and September from 20 permanent sample plots. To define the productivity of the communities and share of every species, the plants were cutted at the level of soil from 40×40 cm sample quadrats. The number of sample quadrats varied according to the heterogeneity of communities from 4 to 25. Now we possess the results of the 132 gatherings, collected in 1995-2009. The Simpson's Diversity Index (D) in associations with average annual productivity (P) more than 350 g/m^2 (377-755 g/m^2) has the value 1.0-1.5 (the monodominant communities), by P 300-350 g/m^2 D has limits within 1.4-4.5, by P 200-300 g/m^2 D value is 1.7-5.9, to P 100-200 g/m^2 corresponds D 1.6-5.2, and in case P<100 g/m^2 D increases to 5.4-6.6. Consequently, the low-productive communities can be monodominant or polydominant, while high-productive phytocenoses are usually monodominant. Thus, we can see a realization of the principle of Gause in natural environment and this regularity may be called as the effect of diversity limitation under high productivity.

Poster D127

The effect of arbuscular mycorrhizal fungal communities from differently managed ecosystems on plant performance

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Evidence is accumulating that the diversity and composition of natural arbuscular mycorrhizal fungal (AMF) communities varies in space and time. Anthropogenic disturbances can shape local AMF communities in plant roots, and thereby, AMF communities may have a different influence the performance of plant species in particular ecosystems. Here we asked how different AMF fungal communities influence plant species growth, and is mycorrhizal colonization level related with plant biomass. We tested the effect of two AMF communities originating from successionally young and old forest stands on performance of ten forest understorey plant species (*Geranium pratense*, *Prunella vulgaris*, *Hypericum maculatum*, *Veronica chamaedrys*, *Fragaria vesca*, *Plantago lanceolata*, *Primula veris*, *Trifolium pratense*, *Geum rivale*, *Solidago virgaurea*). The forests were boreo-nemoral forest with rich AM plant understorey. In pot experiment we measured plant biomass and estimated AMF root colonization to compare plant species growth response to live soil inocula. Additionally, biomass of six plant species (*G. pratense*, *P. vulgaris*, *H. maculatum*, *V. chamaedrys*, *F. vesca*, *S. virgaurea*) was also measured for naturally growing plant individuals to compare those results with experimental results. AMF inoculum from old forest stands resulted in generally larger understorey plant growth in experimental conditions than inoculum from young forest stands. *G. pratense* and *P.vulgaris* showed greater positive mycorrhizal growth response to old forest than to young forest inoculum. *H. maculatum* showed higher positive growth response to old forest inoculum with respect to shoot biomass and *V. chamaedrys* with respect to root biomass. *F. vesca*, *P. lanceolata*, *P. veris*, *T. pratense* and *G. rivale* showed no difference in response to old and young forest inoculum, *S. virgaurea* grew better with young forest inoculum. The naturally growing plant individuals of *G. pratense* and *P. vulgaris* were also significantly larger in old stands, but the biomass of other plant species did not differ among the two successional stages. The AMF colonization in experimental plant roots was significantly affected by host plant species (ranging from average of 22% for *V. chamaedrys* to 91% for *F. vesca*), but not by the type of inoculum. Also, plant biomass had positive correlation with root AMF colonization level.

In conclusion, AMF communities with different forest management history had positive to neutral effect on the growth of host plant species which was in accordance with the results of plant species growth in the field site. Correlation analyses confirmed mycorrhiza importance for the plants.

Poster E191

Boreal urban vegetation and biotopes

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Background
In urban areas the impact of building development and other human activities rapidly changes, reduces and frag-
ments nature (e.g. Dunn & Heneghan 2011). Concerning cultural habitats in Europe, the classification of vegetation
and land use types have been variable and sometimes confusing, since CORINE 1992.
In many boreal towns and cities most endangered vascular plant species live on unclassified biotopes, if they do not
grow on dry and rocky meadows. Vegetation studies in boreal towns show seldom distinct indigenous communities of
vascular plants, because the species appear in impoverished mixtures on their biotopes (Kurtto and Helynranta 1996,
Vähä-Piikkiö 2002). An insufficient biotope inventory has discouraged environmental officials of Helsinki, causing
problems in conservation planning.

Objectives
This study aims to develop scientifically based cultural biotope classification that serves planners working on different
sectors of urban nature and environmental policy. The first prerequisite for understanding, creating conservation and
management is that urban biotopes are carefully described. In Helsinki city, vegetation has described in Lauttasaari
suburb, where also populations of two vascular plant species have been compared, the other an "urban" strategist.

Three methods are used:

A A biotope and vegetation study has been conducted in Lauttasaari suburb of Helsinki, consisting of 54 sites of 1
m². Environmental factors (like soil, N/P, exposition, disturbance) complete PCA-analysis.
B Data from public boreal urban vegetation and biotope research sources will be compiled as
a literature study in 2014. If possible, community and environment data is extracted for a com-
parative analyse, baring national vegetation and biotope classification in mind.

C A comparative plant population analysis of strategies of two vascular plant spe-
cies: The other "urban", possibly either on "urban" biotope, too. The data on structures, re-
productive allocation and seed banks, will be gathered in summer 2013.

Preliminary conclusions
In lack of a comprehensive biotope inventory of Helsinki, the Lauttasaari biotopes may give rise to a general GIS-
model of urban biotopes in Helsinki. That could be used for testing how well land cover or land use classifications
predict valuable biotopes. New insights of urban biotopes in relation to the present natural ones would perhaps renew
the European classification too.

Poster A19

Biotic and abiotic characterisation of embankment vegetations along navigable waterways in Flandres

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In Europe the area of traditionally managed semi-natural grassland habitats has been reduced dramatically during
20th century. In highly fragmented landscapes with few or very small semi-natural habitats left, embankments and
other small habitat patches can have an ecological importance for the maintenance of semi-natural grassland species
and in improving ecological processes. Consequently, a better knowledge of abiotic variables affecting biodiversity in
small habitat patches is desirable.

We studied the vegetation and expected determining abiotic variables in embankments along navigable waterways in
Flandres. In total 542 vegetation relevés (of 4 m²) were made on the slope or crown of embankments along 6 different
waterways. By means of TWINSPAN main clusters of vegetation composition were distinguished. Soil variables were
determined in 200 plots, selected in such way that plots were equally distributed in main vegetation clusters.

TWINSPAN showed 5 main clusters of vegetation types: cluster 1 characterised by *Cytisus scoparius*, *Rumex acetosella*
and *Rubus* sp.; cluster 2 differentiated by *Festuca rubra*, *Achillea millefolium*, *Daucus carota*, *Leucanthemum vulgare*
and *Centaurea jacea*; cluster 3 typified by *Holcus lanatus* and *Arrhenatherum elatius*; cluster 4 classified by *Urtica dio-
ica*, *Galium aparine*,*Anthriscus sylvestris* and *Elymus repens* and cluster 5 distinguished by *Symphytum officinale* and
high coverages of *Urtica dioica* and *Galium aparine*.

Highest mean number of species and Shannon Wiener diversity was noted in cluster 2; lowest in cluster 5. Lowest
mean Ellenberg indicator value for nutrients was observed in cluster 1; highest in cluster 5. Soil variables showing
important differences in the main vegetation clusters were cation exchange capacity, mineral nitrogen and total phos-
phorous. Mean values for these soil variables were lowest in cluster 1 and highest in cluster 5.

Understanding the influence of abiotic variables on vegetation composition can contribute to an appropriate ecologi-
cal conservation, management or restoration of embankments along navigable waterways.

Poster D153

Year-to-year compositional shifts in a Texas, USA, *Taxodium* swamp following exotic species invasions

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Caddo Lake, on the border between Texas and Louisiana, USA, is known for its extensive *Taxodium distichum swamps* and is an internationally important wetland under the Ramsar Convention. In 1995 we established permanent plots and described wetland plant communities along a hydrological gradient. We re-sampled in 2005, 2009, 2011, and 2012. 1995 communities were largely dominated by native species with *Eichhornia crassipes* (water hyacinth) restricted to a limited area. By 2005 *Eichhornia* had become abundant in most of the study area and *Alternanthera philoxeroides* and *Hydrilla verticillata* had increased. By 2009, *Salvinia molesta* (giant salvinia) had established and become abundant throughout and *Eichhornia* remained abundant. During 2011, a severe drought year with near record low water levels following a cold winter, *Salvinia* and *Eichhornia* declined steeply in abundance but were still widely distributed spatially. *Salvinia* recovered strongly in 2012 with the return of normal conditions, apparently at the expense of *Eichhornia* which did not regain 2005 or 2009 abundances. These changes were reflected in canonical correspondence analysis results. The first axis was correlated with plot elevation and the underlying hydrologic gradient. The second axis was correlated with sampling year and reflected an overall increase in non-native species and a corresponding decline in natives. The third axis was correlated with seasonal water levels: Samples from low-water years (2011 and to a lesser extent, 2005) had low scores and those from normal or wet years (1995, 2009 and 2012) had intermediate or high scores thus reflecting weather-related year-to-year shifts in post-invasion wetland vegetation. Partial segregation of each year's samples into different regions of ordination space indicate that year-to-year vegetation fluctuations are typical of southern swamps and suggest water level manipulations as a possible *Salvinia* management tool.

Effects of arbuscular mycorrhizal fungi on sexual intra- and inter-specific competition in *Antennaria dioica*

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Most plants form mutualistic symbiosis with arbuscular mycorrhizal fungi (AMF) in their roots. AMF have the potential to affect competitive interactions among plants by mediating resource acquisition and allocation patterns. Differences in competitive ability between the sexes in dioecious plants are expected as a result of allocation trade-offs associated with sex-differential reproductive costs. Even though sex-specific interactions between AMF and dioecious plants have been reported, the effects of AMF on plant competitive abilities have been largely neglected.

We evaluated sexual competition (SC) using the dioecious plant *Antennaria dioica* in two separate experiments. First, in a common garden transplantation experiment we investigated intra-specific SC by growing for three years *A. dioica* males and females either alone or with another *A. dioica* plant (intra-specific competition) from the same sex or from the opposite sex. Second, in a greenhouse experiment we evaluated how AMF symbiosis affects intra-specific and inter-specific SC. Females and males were grown as in the previous experiment and also in competition with *Pilosella* spp. (inter-specific competition) in a factorial design with or without AMF. In both experiments, we assessed plant survival, flowering phenology, sexual and asexual reproduction, growth and AMF colonization in the roots. Our results show little evidence of sexual differences in competitive ability. Both sexes suffered similarly from competition, and competitive effects were manifested in some traits related to fitness but not in others. Survival was unaffected by competition in both experiments, but competing plants reduced their vegetative growth compared with non-competing plants. Inter-specific competition was stronger than intra-specific competition and the sex of the competitor was not important for mass acquisition. Differences in SC ability were observed in relation to flowering frequency: in both approaches females reduced flowering, especially when growing in competition with the same sex in the common garden. Symbiosis with AMF did not influence plant survival but reduced the proportion of flowering plants and did not affect clonal growth or mass acquisition in the greenhouse experiment. While the levels of AM colonization in the greenhouse experiment are still being assessed, similar amount of AMF in the roots were observed in the common garden.

These findings indicate that female and male *A. dioica* plants possess similar SC abilities, which may be related to the similar costs of reproduction between sexes reported for this species. AM symbiosis did not modify competitive abilities in our study, suggesting that both sexes obtain a similar benefit from the symbiosis.

Poster B77

Patterns of plant species co-occurrence in coastal sand-dunes of Northwestern Portugal

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Coastal sand-dunes are vulnerable and dynamic ecosystems under several pressures. Insights from patterns of plant communities across environmental severity gradients are essential for an effective coastal management.

Here, patterns of plant species co-occurrence are scrutinised through whole coastal dune systems, across a regional biogeographic gradient, climate related, and a local sea-inland gradient, related to abiotic stress and disturbance. Also, the results obtained are discussed within the assumptions of the "stress-gradient hypothesis" and the "humped-back model", controversially debated in the last decade. A total of 92 plots were surveyed in five dune habitat types across a sea-inland transect (from embryonic foredunes to scrubland), at seven locations through a main biogeographic transition (between the Eurosiberian and the Mediterranean regions) in Portugal. A multi-step framework was applied, calculating standardised scores of species co-occurrence (based on presence/absence and abundance data) for the entire community in the whole study area (Step One) and along the biogeographic (Step Two) and the sea-inland (Step Three) gradients.

Overall, a humped-back shape for species diversity through the local gradient was observed, and co-occurrence analyses revealed the prevalence of species segregation. Although no regional trends for co-occurrence values were found, species segregation in the study area and across sites was observed, suggesting the prevalence of species competition, probably expressing environmental heterogeneity. Across the local sea-inland gradient, shifts from species aggregation to segregation were detected. Even so, a trend for species aggregation at intermediate levels of environmental severity was perceived, supporting recent refinements of the stress-gradient hypothesis and the humped-back model regarding plant community assembly rules and diversity. We argue that at regional scales environmental heterogeneity within each site seems to overcome the effects of the biogeographic transition favouring species sorting and segregation across the sea-inland gradient. Nonetheless, within each coastal habitat, plant species interactions prevailed at local scales, suggesting that patterns of species co-occurrence in the study area result from both habitat heterogeneity and biotic interactions.

To our knowledge, this is the first study evaluating species co-occurrences within the whole dune system, analysing presence/absence and abundance data against regional and local gradients. Overall, our results are consistent with recent theory and refinements of the main hypotheses addressing species co-occurrence. They can thus contribute to improve the efficiency of assessment and reporting on the condition of dune habitats and biodiversity.

Poster E192

The use of line transects for a better description of river bank vegetations

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This study describes the monitoring of riparian bank vegetation by two different methods : the quadrat method and the line transect method. The aim is to evaluate the diversity of habitats related to river banks. The use of the quadrat method is widespread in vegetation analysis of river banks. However this method has serious restrictions in relation to the homogeneity of the vegetations, especially when monitoring narrow river banks. To obtain a better alternative, the quadrat method and a line transect method were compared using the Wilcoxon rank test, by calculating a weighted average of Ellenberg indicator values of all species present on a plot. The moisture value was the most appropriate variable to describe changes, perpendicular to the water line. The significant differences between both methods were analysed for different vegetation types.

The comparison of both survey methods revealed no differences for reed and grassland vegetations. On the other hand, nitrophilous edges and marsh vegetations revealed a significant difference between the plots at the water level and the plots at slope level for both methods. But, when comparing the different time periods, some differences could not be detected when the survey was performed by quadrats. No significant changes were detected for nitrophilous edges, while colonisation of the shallow water zone by macrophytes for the marsh vegetations resulted in non-significant differences between water line, slope and crown. On the opposite, the changes for both vegetation types were apparent with the line transects.

The line transect method produced a much better description of the spatial gradient complexity. Especially when comparing different time periods, the quadrat method shows no changes in vegetation development, while the changes were obvious when using line transects. Exceptions to this general rule could be found amongst species poor vegetations like reedbeds and grasslands. The use of the most efficient monitoring method is determinant to accurately evaluate the present gradients and the gradients after an intervention has taken place.

Functional traits incorporated in hierarchical species distribution models

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Relating plant traits and the environments plants inhabit is important for building a mechanistic foundation for biogeography and community assembly. Species distribution modelling is a rapidly growing field that has expanded insight into the nature of species niches. However, species distributions are most often modeled individually, which misses insights from comparative approaches. By contrast, the traits literature has focused on characterizing the flora or community as trait distributions, ignoring the fact that those traits are possessed and expressed by individual species. Our aim has been to consider the traits of the species as interacting with the environment to determine the probability of occurrence of species. Here we describe an approach using multilevel (or hierarchical) generalized linear models adopting this position to model species distributions and to probe how different traits determine species occupancy responses to environmental gradients. We will explain the workings and interpretations of the model drawing primarily on a case study of the traits (specific leaf area, maximum height and seed mass) of ~20 eucalypt tree species distributed across environmental gradients (e.g., rainfall, insolation, soil type and rockiness) in the Grampians, an isolated mountain range in SE Australia. We have found this a useful and formalized way to capture how species functional traits influence the response of species to environmental gradients.

Analyses of autocorrelation in species ordination space

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This study aims to evaluate factors influencing plant species richness on forested islands, such as island species-area relationship (ISAR) , forest canopy dominant (alien vs native Pine), and past land use history. In addition we seek to assess how autocorrelation, viz. dispersal between islands, may affect the results with respect to space defined by geographic coordinates and species ordination. The standard approach to solve the autocorrelation challenge is to use spatial geographical coordinates in partial regression, analyses of residuals, or autoregressive techniques. Species richness, however, is an aggregate of presence of many individual species, and therefore qualitatively different from other ecological variables. Similar numbers of species in neighbouring islands are only critical if these are shared species. Thus species composition, expressed as location in species ordination space, is the crucial indicator of contagious biotic processes that may violate the assumption of independence between samples. The rationale is that if two neighbouring islands have the same number of species, but a totally different flora, the number of species is actually statistically independent (no effect of the proximity in geographical space). Although this extreme example is unlikely in nature, it illustrates how the degree of shared species will also determine the degree of statistical independence between the islands. Many shared species yield high statistical dependence and vice versa, i.e. species-space autocorrelation. We used ordination, regression, and autocorrelation analyses on a binary data-set of plant species on 70 islands, in North Atlantic coast, West Norway. This archipelago was part of the ancient and widespread treeless heathland found along the European west coast, and reforested with Pine since early last century. We found more plants on the islands with introduced than native pine, and the latter had not a significant ISAR. This related to similar underpinning causes, i.e. species from the old land-use system have survived on islands with introduced *Pinus mugo* forest, but not in the late-successional forest of native *P. sylvestris*. We detected a missing explanatory variable in the model by calculating Morans' I in species ordination space based on the residuals from regression models. One potential candidate, a grazing indicator variable, indicated that species associated with the previous land-use system (grazing) prevail on islands with introduced pine and contributed to the demonstrated enhanced richness. Hence autocorrelation, particularly in species ordination space, may aid interpretation of plausible causal links in diversity analyses rather than causing problems.

A model-based predictive framework to improve monitoring of alien plant invaders under environmental change scenarios

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Monitoring programs have been set-up across regions and geographic scales to track biodiversity and ecosystem changes caused by recent and on-going shifts in environmental and social-ecological systems. Monitoring is an expensive task due to the many biological and ecological targets, to the skills required to collect and analyse data and to the statistical power required to draw inference. Limited resources require priorities to be adequately established in time to ensure progress towards global conservation targets. Therefore, monitoring programs need to be cost-efficient but also effective in detecting changes in order to allow anticipation.

Species Distribution Modelling (SDM) is one powerful correlative approach that has already proved successful to provide quickly geographic projections from a single species to a community level. SDMs could contribute to improve the effectiveness and (cost-) efficiency of current monitoring schemes while setting a framework to develop new ones. Further, model projections could be used to assess if current monitoring networks would still be appropriate to meet the initial conservation targets under global-change scenarios. There would thus be many advantages in the wide use of models to improve the monitoring of biodiversity change across scales (e.g. the detection of changes in key pressures and threats, such as biological invasions).

Here we present examples of how SDMs can be applied to improve coverage and sampling design, and to test hypothesis on the effects of pressures like climate change on the patterns and rates of invasion. We propose a framework combining model calibration for problematic invasive plants with model-based scenario analysis to improve the assessment of invasion at regional and local scales. Application of this novel framework would bring invasion monitoring closer to policy and management needs while ensuring cost-efficiency and adaptability in the face of rapid environmental change.

Effects of the changing landscape on forest plant species biodiversity: a story of two tales

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The European landscapes have experienced significant changes in configuration during late Holocene. A primarily forested continent, have changed to a mosaic of anthropogenic urban and rural landscapes, mixed with forest fragments of different size. During the last centuries there have also been large changes within the forests with a directional transformation of forests to forest plantations. In this study we have tested the influence of forest size and forest edge lengths in the landscape on plant species richness and coverage in forested habitats in the Baltic Sea region. Our findings indicate that plant species with their main occurrence in the forest edge community are positively affected by the fragmentation of forests while the true forest species seem to be unaffected by forest area or forest edge length.

Vegetation and soil properties predicted using satellite image data in North-eastern Siberian tundra

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When aim is to understand the regional carbon dynamics, spatial information about vegetation and soil properties is needed. In our Tiksi study area (71°35›39»N, 128°53›17»E) CH_4 and CO_2 flux and concentration measurements have been done since 2010. Our aim is to create vegetation and soil data sets which can be used, when these flux measurements are analysed and regionalised. We measured 52 intensive vegetation study areas, on which general coverage of vegetation communities and plant growth forms were estimated in late July 2012. Each of these areas also included 3 intensively studied plots, on which plant coverages and lengths were determined by plant species, or in some cases, by some larger taxonomical units. From 28 of these same sites soil properties (litter layer depth, depth of unfrozen soil, organic matter content, soil moisture) were measured and LAI (leaf are index) samples collected. The following vegetation communities were found: tundra heaths with lichen and/or moss field layer, tussock tundra and meadows, and paludified peatlands varying from shrubby bog to wet fens. There is also some streams, ponds, and stony, non-vegetated patches. The depth of unfrozen soil above permafrost varied from few cm to about 40 cm depending about the type of vegetation and land cover. We have purchased 2 high resolution satellite images from the study area: Quickbird (4 channels, pansharpened to 0.6 m pixel size, acquired on 15.7.2005, presenting situation in early part of the growing season), and WorldView2 (8 channels in 2 m, one channel in 0.5 m, acquired on 11.8.2012, presenting situation in late part of the growing season). Vegetation type and land cover classification can be produced in acceptable accuracy. Typically, segmentation techniques are needed, when these kinds of extremely high resolution images are classified, but due to lowness of the vegetation causing lack of shadow effects, even pixel based methods can be used. Satellite image based NDVI (Normalized Difference Vegetation Index) explains spatial variation in LAI, total plant cover and moss cover. Variation in NDVI based 2005 image explains better the variation in shrub cover and the variation in NDVI based on 2012 image explains especially the variation in grass and herb cover. When soil properties are analysed, it seems that spatial variation in soil organic matter content and depth of unfrozen soil can be well predicted using satellite image data.

Structural forest types and tree species diversity in landscape with active coppice management

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Coppicing has been widely used in Europe and abandoned in many regions since the first half of 19th century. Abandonment of this traditional forest management practise is supposed to be one of the causes of decreasing species diversity. Depending on the density and pressure of human population, besides of the active coppicing, other management practises could play an important role such as forest pasturing or abandonment of forests or pastures resulting in various forest structural types. We focused on the south-west Romania, village Sfânta Elena, where coppicing is still active practise. To assess forest structure and tree species diversity, we established 24 circular sample plots (18 m diameter) where positions of stools or individuals were measured using Field-Map technology, DBH of each stem with more than 5cm was measured and species was determined. Locations of sample plots where selected using stratified random selection reflecting distance from the village, slope and aspect. Sample plots where classified into four structural forest types categories: active coppices, abandoned coppices, high forest and shrubs. For each plot, we calculated several parameters of tree layer, e.g. basal area, basal area and counts of generative individuals, stools, dead stems, stumps and others. When analysed using principal component analysis, we found clear distinction between the four structural forest types. Shrubs, abandoned coppices and high forest comprised continuum gradient and active coppices stood somewhat alone mainly due to presence of stem cuts and higher numbers of stems per one stool. Diversity of tree species was assessed using Shannon diversity index. While the species richness of trees was almost the same between structural categories, diversity of trees tended to be lower in high forest and in active coppices and increased in abandoned coppices and shrubs. In the next step, we want to extend our analysis to herb layer composition and diversity.

Why some plant species are rare

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Biodiversity, including plant species diversity, is threatened worldwide, as a result of anthropogenic pressures such as an increase of pollutants and climate change. Especially, rare species are on the verge to become extinct. The reason why some plant species are rare and others are not is still unclear. Are they rare for intrinsic reasons, due to limiting dispersal capacity, effects of management or abiotic circumstances? Niche preference of rare plant species may play an important role in why some species are rare and others are not. We investigated if rareness is due to a small niche preference for abiotic soil parameters based on a huge data set of measured soil parameters. For in total 23 different abiotic soil parameters, amongst which groundwater table, soil pH and nutrient contents, we estimated species responses for common and rare species. Based on the responses per species we calculated the range of occurrence, defined as the range between the 5 and 95 percentile of the response curve giving the niche of the species. Subsequently, we calculated the average response range for common and rare species.

The niches of rare species for abiotic soil conditions are significant smaller than for common species. Twenty of the twenty-three abiotic parameters showed on average significant smaller niches for rare species than for common species, none of the abiotic parameters showed on average a smaller niche for common species.

The results have major implications for the conservation of rare plant species; management and nature development have to be focussed on the maintenance and creation of small niches, both in space and time. Especially the conservation of (abiotic) gradients within ecosystems is important to preserve rare species.

Does functional diversity show maximum in fine-scale diversity hotspots?

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Background: The concept of limiting similarity suggest that species can more readily coexist if they differ in their traits related to resource-use characteristics. Therefore, we hypothetise positive relationships between fine-scale functional diversity of competition based traits and local species richness. Location: Dry abandoned mountain grasslands in a representative pastoral landscape in the central Apennine Mountains (Torricchio Nature Reserve, Italy).

Methods: Fine scale co-occurrence patterns were detected along 52 m long circular belt transects of 1040 units of 5 cm × 5 cm contiguous microquadrats. Five stands were sampled in contrasting North and South facing slopes. Functional diversity was calculated at a series of scales from 5 × 5 cm to 5 × 25 cm using species-level traits related to competition, regeneration, establishment, dispersal and flowering. We tested for assembly rules of different traits and for correlations between the functional diversity of different traits, the fine-scale species richness, and the presence of dominant grass (*Sesleria nitida*) using randomizations tests.

Results: While previous studies often found random patterns of multiple traits, in our study we detected non-random assembly in most investigated traits. Although, functional diversity differed from null models, trait based assembly rules showed great variation according to habitats, fine-scale environmental differences and plant traits. Local species richness was negatively correlated to the presence of dominant grass but it was unrelated to the local functional diversity. In contrast, the spatial variability (dispersion) of functional diversity correlated with local species richness and showed minimum dispersion in diversity hot spots.

Conclusions: Fine scale spatial organization of plant traits does not follow the predictions of niche theory in abandoned mountain grasslands, probably because of the predominant effects of dominant grass that suppress all subordinate species. Diversity hotspots appear in small isolated gaps within the matrix of dominant grass and local trait based assembly processes diverge greatly within this matrix.

Poster D108

Limitations of northward treeline expansion in Siberia - Comparing field survey results with individual-based vegetation modelling

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The Siberian treeline, which is exclusively formed by different *Larix* species, follows approximately today's 10 12 °C July isotherm. A northward expansion of boreal forests into tundra regions due to climate change is assumed and might result in e.g. decreased albedo, increased carbon sequestration and evaporative cooling, as well as altered vegetation composition. Hence, the question of when and how far the treeline advances is of particular interest. Reproductive capacity and the establishment of seedlings at the treeline are assumed to represent major processes that limit northward treeline expansion. We investigate past treeline transitions by applying two different procedures. Our first approach is based on a detailed field survey, conducted in 2011 near the Taimyr Peninsula, North Siberian Lowland, during which we investigated the stand structure of *Larix gmelinii* at four different sites (between 70.6° N and 72.4° N) in the tundra-taiga ecotone.

There is reason to suspect that different limitations govern the reproductive success across the arctic treeline along a north-south gradient. Based on our data we hypothesise that reproductive success in the north, at the species boundary, is mainly limited by the amount of seed-producing trees, whereas in more southern regions, with denser crown cover, competition is the main restricting factor. Between these edges of the tundra-taiga ecotone, we hypothesise temperature to be the most important factor controlling reproduction.

The second approach comprises a vegetation model in order to test our hypothesis with different input-scenarios. In this next step, we want to investigate the influence of various driving factors on the reproductive success of *L. gmelinii* in the tundra-taiga ecotone and point out possible future changes of the treeline position in this region.

Poster B67

Microclimatic variability within topographically complex landscape and its influence on plant species composition

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Background: Topographic variability within landscape creates specific habitats with sharply different microclimatic conditions. This variability is especially important in sandstone landscapes with nutrient-poor substrate, but extremely complex relief and can be responsible for their high plant beta diversity.

Objectives: We performed detailed (30 min. interval) and several years lasting measurement of air and soil temperature and soil moisture in order to describe site microclimate and relate it to plant species composition in sandstone region with complex topography (Bohemian Switzerland, Czech Republic).

Methods: We used newly developed, autonomous microclimatic unit TMS1 to measure temperature directly at the soil surface, 10 cm below and 15 cm above it (sun shielded) and soil moisture in the first 15 cm below ground. About 300 TMS1 units were installed in 6 valleys in 2010. Individual units were placed in regular distance along valley floors and on several profiles perpendicular to valley floor in the strata given by the same relative height above the floor. Plant species composition was recorded in 1 m2 area surrounding each TMS1 unit. Further, hemispheric photographs were taken in place of each installed unit to filter out the effect of tree canopy cover.

Results: We found that microclimate in deep valleys is more stable, with colder temperatures during the vegetation period but warmer during the winter period. Such colder but more stable climate allow occurrence of many oceanic, mountain or even alpine species in this low elevation region. The herb layer species composition in the study area is strongly influenced by previous silviculture practises resulting in Norway spruce monocultures. Nevertheless, the multivariate constrained ordination showed three basic microclimatic gradients well reflected by plant species composition: soil moisture (culminating in deep valleys), temperature extremes (culminating on rock tops and crest) and temperature stability typical for drier habitats in the floor of valleys.

Conclusion: Diverse topography of sandstone region creates high variability of microclimatic conditions, which underline high vegetation variability within relatively small area. The specific microclimate in deep sandstone valleys support isolated occurrences of species with extrazonal distribution and allow their long-term survival in these climatically buffered refugia within otherwise unsuitable landscape.

Poster A20

Spatial pattern of tree regeneration after stand-replacing disturbance in Norway spruce forests

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Background: Large-scale disturbances such as windstorms and insect epidemics affect wide areas, with their influence on forest stands usually interpreted in terms of large-scale, e.g. landscape-level, changes in forest spatial heterogeneity. Changes in fine-scale spatial pattern after such disturbances are typically not examined, even though the pattern at this scale is an important determinant of forest species diversity, living biomass, and future dynamics.

Objectives: The presence of large areas of spruce forest that were affected by a bark beetle outbreak and not subject to human intervention allowed us to study early succession following stand-replacing disturbance in Central European mountain spruce forest (Šumava Mts., Czech Republic). Methods: We measured spatial coordinates and height of all regeneration (6732 individuals) and coordinates and DBH of adult trees (1378) in nine plots covering the broad gradient of regeneration density. We evaluated fine-scale spatial patterns of regeneration established either before disturbance (advanced regeneration) or after disturbance (post-disturbance regeneration) and adult trees using univariate pair correlation functions. We employed the bivariate pair correlation function to explore relationship between different tree-life stages. Finally we fitted two different general point processes (Matérn cluster process and Thomas process) to the observed spatial patterns of regeneration to help identify biological processes underlying the observed pattern.

Results: We found that spruce regeneration is highly clustered at small scales, but adult trees are distributed more-less randomly. Further, we found that both post-disturbance and advanced (established before disturbance) regeneration was clustered around mature trees, indicating that clustering also occurred in living stands. Fitting of general point processes also allowed identification of random component of regeneration spatial pattern, which is formed only by marginal part of individuals. Conclusion: The clustering around adult trees (both living and dead) is the dominant process governing the observed tree spatial pattern. Therefore, the new generation of trees mirrored the spatial pattern of prior forest stands, showing that spatial pattern itself is an important biological legacy driving the regeneration process in mountain spruce forests.

Indicator values (IndVal) mimic ranking by F-ratio in real-world vegetation sample

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When searching for pattern in vegetation samples one may strive for a selection of variables, often termed indicator species. With this objective in mind Jancey (1979) proposed species ranking on a variance ratio (F-ratio) as found in analysis of variance. Almost 20 years later Dufrêne and Legendre (1997) devised their indicator value analysis with the same objective in mind but based on different reasoning. Surprisingly, using their method for ranking species often leads to rather similar outcome as the ranking obtained by Jancey's approach.

This raises the question if (i) the results of the two approaches are equivalent or (ii), if one of these methods is superior in predicting site conditions, biodiversity, succession or other properties of ecosystems. Because the outcome of both methods strictly relies on the vegetation samples used and the predefined classifications we compare results from small and also large real-world data sets and we vary the number of groups involved. The ranking of indicator species identified by either of the methods is then compared with a ranking obtained by correlating species with measured environmental factors.

The results confirm that the ranking by maximum indicator values according to Dufrêne and Legendre (1997) is very similar to the ranking devised by Jancey (1979). Rank correlation reaches a maximum of r > 0.95 when data sets are large and group number is optimized. However, in our examples Jancey's method accords better with the environmental predictive power of species and it outperforms IndVal when applied to continuous variables.

I conclude that the potential of Jancey's method is generally underestimated. The agreement of results between the two approaches depends on the strength of similarity patterns inherent in the data sets analysed. The method of Dufrêne and Legendre (1997) is well adapted to issues of classical phytosociology where data usually are retrievals from databases. The bottleneck for the identification of any kind of indicator species is the quality of the data used rather than the method of classification.

Honorary membership lecture
The four theories in vegetation science

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Theories have never fared well in vegetation science. The Clements/Gleason theory (for their theories were almost identical) is the basis of three major ecological concepts: (1) Environmental filtering: its operation is, as Warming said, "trivial", though it has always been documented and continues to be, with a few brave attempts to find deeper meanings. (2) Switches: they seem likely to be pervasive in natural communities, but evidence for them is sparse. (3) Assembly rules (present in Clements/Gleason theory only as a single aside by Clements): these are essentially micro-scale switches; evidence for them is easy to obtain, but valid evidence much less easy. The elephant in the room is C-S-R theory, testable but hardly tested.

Competition and clonal connections

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Clonal growth in plants is thought to reflect the parasitizing of older individuals (mothers) by younger individuals (daughters), allowing expansion into harsh environments. Evidence for this comes from short-term experiments on herbaceous species. We examined clones of an invasive tree expanding from forest into adjacent nutrient-poor grassland. Over two growing seasons, mothers accumulated ten times more experimentally-added nutrient isotope than did daughters, regardless of whether mothers or daughters were donors. The magnitude of nutrient accumulation by mothers closely matched their leaf mass relative to daughters, suggesting that flow direction is driven by demand. Nutrient flow from daughters in resource-poor grassland to mothers in resource-rich forest is a novel biogeochemical mechanism for resource flux between ecosystems. Further, nutrient accumulation by mothers in forests is a previously unreported mechanism of competition between grasses and trees that may contribute to tree invasion, and the concomitant losses of biodiversity and sequestered soil carbon. Most importantly, this field experiment showed that daughter ramets play the role of helpers, not parasites, by moving nutrients to, not from, mother ramets.

Using species complementarity to select sites for conservation management: which species are most important?

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The principle of complementarity, i.e. defining the minimum set of sites to ensure that all species are represented in a reserve network, underpins systematic conservation planning. Systematic conservation planning has only occasionally been applied to determine the minimum set of sites required to capture the biotic variability within a particular ecosystem type.

Naturally uncommon ecosystems represent distinct environmental conditions and often have a highly specialised and diverse flora characterised by endemic and rare species. In New Zealand, naturally uncommon ecosystems frequently occur outside existing conservation areas so managers and policy makers need to know which examples should be priorities for conservation management. Because many types of naturally uncommon ecosystems are small and embedded within managed landscapes, their biota may be highly influenced by the nature of the surrounding matrix. This means that many of the species that currently inhabit them may be of little conservation value, either being exotic or natives derived from the disturbed surrounding landscape.

Here we focused on selection of priority conservation sites in two naturally uncommon ecosystems in New Zealand: gravel beaches nationally and basaltic outcrops in the Banks Peninsula region. Across 39 outcrops, 78% of the total 350 species were native. Of native species, 79% were original i.e. historically characteristic to the outcrop and 21% were derived from other habitat-types in the surrounding landscape. Similarly to exotic species, the nature of the surrounding vegetation explains more of the variation in composition for derived than original native species. Across 61 gravel beaches 51% of the total 466 species were native. Of native species 87% were historically characteristic and 13% derived. For outcrops, using all species to assess complementarity gives priority to sites representing gradients reflecting both altitude and contrasts in surrounding vegetation. When exotic and/or derived species are excluded, the emphasis shifts to representing altitudinal and soil chemistry gradients. For gravel beaches, using all species gives priority to sites that represent different parts of climatic and geographic gradients, but also ensures that sites that are both dominated by native and exotic species are represented. Interestingly, site prioritisation does not change markedly when exotic and/or derived species are excluded, because the native species occurring on sites dominated by exotics are distinctive. Results indicate that both exotic and native derived species should be accounted for when assessing priority conservation sites, and may be especially important in habitats where there are relatively few exotics.

Topoedaphic factors and land management drive patchy drought-induced woody plant mortality in an encroached semiarid savanna: comparing the 1950s to the 2000s

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Following an exceptional drought from 1951-1957, a study was conducted to quantify rates of dieback for various woody plant species. In 2011, we repeated this study within three long-term grazing treatments that were established in 1948 in order to answer the following questions: How do recent patterns of drought-induced woody plant dieback in Texas semiarid savanna compare to the extended drought of the 1950s? Does the relative composition of the woody plant community shift ubiquitously across the landscape following woody dieback or are shifts dependent on differences among species, soils, land use, and plant demography? We established ten transects in each grazing treatment to quantify the frequency and cover of live and dead individuals for all woody species and compare rates of woody plant dieback among height classes, soil categories, total woody densities, and pastoral treatments. Flash droughts from 2000-2011 were the second most severe since 1919 (low PDSI = -4) and were only surpassed by the prolonged drought from 1951-1957 (low PDSI = -5.17). Drought-induced shifts from one woody plant community to another did not occur uniformly across the landscape. Instead, high mortality rates of mature Ashe juniper trees in deep soils (67.3%, 33 of 49 trees), combined with the recruitment of oak species where grazing had been excluded for the last 60 years resulted in shifts from a *Juniperus-Quercus* woodland to a *Quercus virginiana* dominated overstory with a diverse mixture of short growing shrubs occupying the understory. Species-specific patterns of dieback were contingent on localized interactions between topoedaphic factors and long-term land use and occurred as a result of differences in ecohydrology among soil types, species-specific water use strategies, density dependent mortality relationships, and legacy effects resulting from long-term livestock management practices. Small-scale vegetation shifts pose a challenge for scientists attempting to develop accurate predictions of species-level responses to climate change. Additional studies to assess the importance of legacy effects related to long-term land management, woody plant densities, plant demography, and ecohydrological differences among soil types are needed to develop predictive models which properly reflect the complex patterns of woody plant drought dieback.

Restoration groundwork: testing large-scale soil transplantation to facilitate rapid vegetation development on former arable fields

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The restoration of former arable fields to semi-natural grasslands is an important method for counteracting the loss of species rich grasslands in northwestern Europe. Restoration of these areas is a long process that may take decades or even centuries. High nutrient availability as well as lack of an appropriate seedbank are well-known bottlenecks for restoration. However, recent fundamental research into plant-soil interactions has demonstrated that the soil community also plays a crucial role in driving the secondary succession on ex-arable fields. Yet an explicit belowground perspective in nature restoration has so far not been applied in practice.

Here we report on the first field experiment transplanting soil communities from well-developed nature areas to a new restoration area performed at a spatial scale relevant for restoration practice. In 2006, transplantation of both soil from a species-rich grassland and sods from a heathland were carried out in four replicate areas (2.5-5 ha) at the Reijerscamp (the Netherlands), a 160 hectare ex-arable field. To compare with conventional restoration measures hay was spread over similar areas and these treatments were executed both on the original soil as well as on areas where the top-soil had been removed. After six years the restoration success was evaluated by quantifying vegetation structure and composition in 1x1m plots. Furthermore, fungal (PLFA, T-RFLP), bacterial (PLFA), nematode and micro-arthropod abundance and composition, as well as soil acidity, organic matter and nutrient content were measured in each plot. Preliminary analyses show that the transplantations and particularly the addition of sods has increased plant cover in top-soil removal areas and promoted plant diversity in general. This suggests that soil transplantation may be an effective measure to jump-start the restoration of species-rich vegetation on former arable fields.

Poster A22

Comparison of nutrient-use efficiency between evergreen and deciduous broad-leaved trees in a nutrient-poor volcanic site

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Evergreen broad-leaved trees dominate in the sub-canopy layer of a montane pine forest on a lava flow which erupted from Mt. Fuji about 1000 years ago. The dominance of the evergreen trees may be associated with nutrient-poor soil condition in this site. This study was conducted at the forest to answer the following two questions by analyzing seasonal dynamics of nitrogen (N) and phosphorus (P) in foliage of co-occurring evergreen and deciduous species; Is the nutrient use of evergreen species more conservative than that of deciduous species? Which element is more limitative, N or P? Soils were sampled from the research site every month and available N and P were analyzed. For evergreen *Ilex pedunculosa* and deciduous *Quercus crispula*, 3 shoots were sampled from 5 trees in each species once every month, and dead leaves were collected just after shedding. Each shoot was divided into leaves (each aged leaves for *I. pedunculosa*) and stems, and leaf area and dry weight were measured. Then each sample was powdered, and N and P concentration were analyzed. Then nutrient resorption rate at leaf fall and annual nutrient turnover rate in foliage were calculated and compared between species and between elements.

Available soil N and P concentrations in this site were low throughout seasons. The nutrient resorption rate in *I. pedunculosa* was higher than that in *Q. crispula* for both elements. The nutrient turnover rate in *I. pedunculosa* was lower than that in *Q. crispula* for also both elements. These showed that *I. pedunculosa* had more conservative nutrient economy than *Q. crispula* in the nutrient-poor habitat. The resorption rate of P was higher and turnover rate of P was lower than those of N for both species. This may show that P is more limitative than N for tree growth in this site.

Poster C90

The impact of off-road activity and juniper density on cryptogams in acid dune habitats of a military training area

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Main ecological factors influencing cryptogam diversity in off-road disturbed inland dune environment were assessed. In order to do this, the psammophilous grasslands and common juniper scrub of the Grochalskie Piachy military training area, located in central Poland was surveyed. The study field it the second largest open inland dune area in Poland, consisting of circa 100ha open areas with active dune processes covered partially by *Corynephorus canescens* and *Juniperus communis* vegetation. The set of 47 64m[2] samples were collected using the modified Braun-Blanquet method together with a range of variables, including soil pH, EC, organic matter content and first two soil horizons depths. Off-road disturbance and dune processes intensity were measured as present-absent in 25 evenly distributed points within each plot. There were 32 lichen, 12 bryophyte, 2 liverwort and 29 vascular plant species recorded in all samples, including *Stereocaulon condensatum* and *S. incrustatum* – lichen species of the high conservation value. Off-road disturbance and factors connected to ecological succession, especially juniper abundance are the most important variables influencing the cryptogam diversity. The highest off-road intensity leads to transformation of habitat into its initial stage with active dune processes and within not disturbed patches the succession leads to development of initial pine forest. The highest number of lichen species and also bryophytes and liverworts occurred within not or slightly disturbed habitats, however lichens preferred less juniper cover, than bryophytes and liverworts. Pioneer species and valuable lichen species benefit from small to medium disturbance intensity, while other ecological groups are connected to more advanced succession stages. Small to medium off-road disturbance promotes also young juniper establishment and because of the fact, it is highly probable, that the scrub will last in the future. Diverse off-road activity coupled with juniper scrub increases number of microhabitats and thus is a positive factor promoting coexistence of all ecological groups of cryptogams connected to inland acid dune environment. In our opinion, off-road activity should not be necessary treated as negative and moreover, it may be used as a not expensive nature conservation tool to some extent in order to maintain epigeic, open habitat cryptogam species.

Invasibility of Swiss grasslands: interactive effects of summer drought, site productivity and propagule pressure

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Ecological processes resulting from global change, such as more frequent, extreme summer drought or increased propagule pressure of exotic species, often affect plant communities gradually and may therefore not often be distinctly recognised. Studies have clearly shown that adding more or less seeds of an invader species to sites affects their establishment success. The relative importance of propagule pressure compared with other factors influencing establishment success, such as disturbance and resource supply, is not known.

We performed a seed-addition experiment in twelve semi-natural hay meadows covering an annual productivity gradient in the range of 176-1,211 gm[-2]. At each site, we manipulated summer precipitation ('summer-drought' and 'normal' scenario, n = 3) using rainout-shelters (5 × 5 m) from mid June to end of August 2010. Propagules of 36 species of different origin ('indigenous' vs. 'non-indigenous') were added as inocula of different density (40,000 seeds/m^{2}, 5,000 seeds/m^{2}, control) to small areas (18 × 36 cm) nested within the climate treatment.

We expect that a potentially positive effect of summer drought on invasibility will be especially high at sites of high productivity, where, under normal weather conditions, invasion success is reduced due to high competition for light. Moreover, we expect that propagule pressure has lower impact at high productivity. We present preliminary results based on establishment success of the invaders measured two years after seed addition.

Soil matters: soil variables remarkably increase explained variation of tree beta diversity in subtropical broad-leaved forest

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Variation partitioning of species composition into components explained by environmental and spatial variables is often used to identify a signature of niche- and dispersal-based processes in community assembly. Such interpretation, however, strongly depends on the quality of available environmental data. In recent studies conducted in forest dynamics plots, environment was represented only by readily available topographical variables. Using data from subtropical broad-leaved dynamics plot in Taiwan, we focus on the question whether topographical variables are sufficient to quantify environmental control imposed on vegetation, and how is it improved by including also soil variables.

Our results based on variation partitioning among environmental variables and spatial descriptors (represented by PCNM axes) indicate that soil plays far more important role than topography, and that most of ecological information carried by topographical variables is redundant when soil variables are considered. To gain further insight, we introduced multiscale analysis of spatial structure not explained by environmental variables (component [c] in variation partitioning). Environmental variables are supposed to have broad-scaled spatial pattern, while dispersal processes are likely to produce more fine-scale spatial signature in species composition, although this distinction is heavily dependent on the scale of the study. In our study (forest plot of 25 ha size), if only topography is included among explanatory variables, [c] is represented by substantial amount of broad-scaled spatial variation, indicating that yet other environmental variables were not considered. However, after including soil chemistry among explanatory variables, importance of broad-scaled spatial patterns in [c] decreased in favour of more fine-scale ones, eventually interpretable in the way that important environmental variables have been considered and what is left is signature of dispersal.

We argue that topographical variables are not sufficient to reliably discern between niche- and dispersal-based processes in subtropical broad-leaved forest and that yet other variables, such as soil, need to be considered. Our results underpin the fact that interpretation of component [c] in variation partitioning as the signature of dispersal processes in community assembly is very sensitive to quality of available environmental data.

Indicatory plant communities of the dynamic vegetation circles. The Bogdanka river valley case study

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The dynamic vegetation circle (DVC) consists of natural plant community and of all communities that can possibly develop on its habitat as a result of different forms of human activities. Among a series of those replacement plant communities such ones which show the strongest connection with the final community, are defined as indicator communities. They can be recognized after some parameters describing the habitat and to same extent also by their floristic affinity.

The study was conducted in the Bogdanka river valley which functions as a "green wedge" in the spatial structure of Poznań city (Poland). Upper part of the catchment is quite natural on the contrary to the lower part which is strongly anthropogenically transformed. This location determines the wide range of possible replacement communities, differing in terms of structure, durability and origin. Almost 630 original and 130 taken from archives phytosociological relevés were made according to the Braun-Blanquet method in the years 2006-2012 and in 1995-1996, respectively.

The aim of the study was to ascribe all (82) recognized plant communities to the dynamic vegetation circles defined by following final natural communities (*Carici elongatae-Alnetum*, *Fraxino-Alnetum* , *Querco-Ulmetum* and *Galio sylvatici-Carpinetum*), which represent a „mature vegetation types" of this area. For recognizing DVC based on the relationship between actual vegetation, vegetation dynamics, and environmental factors expert-knowledge method was crucial. Its results serve as a reference point for the effect of partitioning method and fidelity measure of each cluster. Local indicator communities, within the set of all replacement plant communities, and important indicator species have been presented.

Elevated temperature may accelerate invasion of exotic shrub *Lantana camara*

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The earth is getting warmer, and species will differ in their responses to elevated temperature depending on their environmental niche properties and physiological characteristics. *Lantana camara* is among the 100 World's Worst Invasive Alien Species and also one of the most notorious weeds in South China. From CLIMAX model, its potential distribution will expand under current and future climate scenarios. But there is a lack of experimental support. We conducted a pot experiment, using branch cuttages of *L. camara*, growing at three temperatures (22°C, 26°C and 30°C). Results showed that, total biomass of *L. camara* increased with increasing temperature. According to allometric scaling analysis it allocated more biomass to stems and expanded its leaves as much as possible at 26°C and 30°C for better light capture and assimilation. As for characteristics of photosynthesis and chlorophyll fluorescence, the seedlings were not stressed by higher temperature, while their photosynthesis and assimilation was enhanced with increasing temperature. Using lettuce as the receptor plant in a bioassay experiment, we also tested the leachate phytotoxicity of *L. camara* at different temperatures. All aqueous extracts from fresh leaves significantly inhibited the germination and seedling growth of lettuce, and the allelopathic effects became stronger with increasing temperature. We concluded that *L. camara* is capable of taking advantage of the opportunities emerging from warming climate, for enhanced colonisation and population growth.

Poster B68

Adaptive response of growth and reproduction traits of a clonal plant *Veronica chamaedrys* to mowing*

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Abstract: Wooded meadow is a semi-natural habitat where mowing is a driving disturbance factor that generates remarkable plant species diversity. Most plants in this ecosystem reproduce clonally; therefore the effect of mowing on clonal growth traits as well as flowering success could explain large part of variation in population dynamics of plants here. We measured the growth and reproduction of *Veronica chamaedrys* in natural conditions differing primarily in presence of mowing. We excavated twenty clonal fragments of *V. chamaedrys* from unmown wooded meadow and mown wooded meadow before mowing season and measured morphological traits and biomass allocation of their modules. The results showed that plant in mown conditions tend to be smaller than in unmown conditions and more biomass is allocated to underground parts in mown conditions. Plants had lower specific leaf area (SLA), average internode length in unmown conditions than in mown meadow. The ratio of flowering ramets to vegetative ramets is higher in unmown meadow compared to mown meadow, although there is no difference in biomass allocation to flowers. The results demostrate strong adaptability of morphological traits to mowing. Smaller size but higher SLA with stronger allocation to belowground organs and more pronounced clonal propagation are all adaptive responses which reduce damage done by mowing.

Key words: Clonal propagation, reproductive strategy, sexual reproduction, biomass allocation, *Veronica chamaedrys*, wooded meadow.

Poster A23

Does fire break the dormancy and enhance germination in species of Brazilian Cerrado?

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Fire is one of the most important factors affecting plant communities in Brazilian tropical savannas (Cerrado), but less is understood about the regeneration strategies and fire-related germination cues. Thus, this study aims to evaluate the effects of fire on the breaking of dormancy and stimulating germination of seeds of *Fabaceae* (hard-seeded coat and physically dormant) and *Melastomataceae* (soft-seeded coat and physiologically dormant). We hypothesize that seeds of *Fabaceae* (*Mimosa foliolosa, Mimosa sp*) will have their dormancy broken after the exposure to high temperatures, while the seeds of Melastomataceae (*Comolia sertularia* and *Tibouchina cardinalis*) will have their germination enhanced after the smoke treatments. Therefore, we exposed seeds (5 replicates/20 seeds/species) to different heat shock treatments (60°, 100°, 150°, and 200°C) combined with time of exposition (1' and 5'). We also prepared smoke solutions and soaked seeds (5 replicates/20 seeds/species) for 24hs into solutions 1:1 and 1:10 concentration. Seeds of control for heat shock were not exposed to high temperatures and for smoke experiments they were soaked in distilled water for 24 hs. Germination percentage was low for most of the study species (except for *Mimosa sp*, >60%). Seeds of *Melastomataceae* showed very low viability (< 35%), explaining the low percentages of germination. Treatments affected seeds of the study species in different ways. *Mimosa foliolosa* had a higher percentage of germination after the 100°C-1' treatment (23%) in comparison to the control (8%, p≤0.05). Germination of *Mimosa sp*. did not seem to be affected by the heat shock experiments, showing high germination percentages in both control and 60°C treatments. In general, all species were affected negatively by the exposure to temperatures >150°C for 1'. The longest exposure to high temperatures (5') led to a decrease in germination for all study species. Smoke enhanced the germination of of *Tibouchina cardinalis* seeds (1:1 treatment, 23%, p = 0.03). *Comolia sertularia* showed very low germination percentages (1 – 4%) in all treatments. Thus, we confirmed our hypothesis about the break of dormancy for hard-seeded species after the exposure to higher temperatures and the enhancement of germination after smoke treatments in soft-seeded species for at least two species: *Mimosa foliolosa* (Fabaceae), and *Tibouchina cardinalis* (*Melastomataceae*).

Leading ecological factors of Republic of Karelia middle taiga sub-zone dry meadow vegetation

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Dry meadows occupy ca 0,7% of Republic of Karelia territory. Major dry meadow-lands are situated in the southern part of the republic. Even there they occupy 1% to 6% of terrain area. The objectives of the study was to establish how the main factors of ecological space change across the studied region of middle taiga sub-zone of Republic of Karelia and how species diversity changes in the space of these factors. The area observed was break up into six districts with varying both environment conditions and human impact. One of six districts has intensive agriculture in the present (Olonets, providing ca 70% of current agricultural production in Karelia), three of them had extensively developed agriculture until the 1950-60th (Zaonezhie, North Ladoga and Vodlozero) and two of them are characterized with poor agricultural use both in the present and in the past (Pryazha and West Onego). Each district meadows were described with 100 to 400 1 m^2 plots (1385 plots totally). Non-metrical Multidimensional Scaling (NMS) ordination was used to find main ecological gradients within each district. Ecological interpretation was made with using environmental values by H. Ellenberg, E. Landolt, L. Ramenskiy and D. Tsyganov. Species density (spp number per 1 m^2) was used as a measure of species diversity.

The results are as follows:

1) The main ecological factors in all districts investigated were soil nitrogen pool, soil grain size and light conditions. Extra factors like soil moisture, soil hydrological regime and pastoral impact can be found as secondary ones for vegetation observed.

2) Two main gradients (normally soil nitrogen and soil grain size) each time provided 25% to 35% of total variance. At the same time soil nitrogen was the main factor inside the districts with developed agricultural impact (both in the present and in the past) while soil grain size was the main factor inside the districts with poorly developed agriculture.

3) Species density has significant negative correlation with soil nitrogen value. At the same time species density is significantly higher in the districts with low agricultural use.

Since soil nitrogen pool is mainly dependent on human impact, it can show that human activities have the main importance for modern grassland biodiversity on Middle Taiga dry grasslands. However soil grain size becomes the leading factor in the places with mainly traditional land-using.

Mycorrhiza and plant communities – is there a link?

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The possible impact of mycorrhizal fungi on plant community diversity and composition has been long discussed, but the actual role of mycorrhiza remains uncertain. Symbiotic fungi influence growth and reproduction of experimental plants, and affect experimental plant communities, but field evidence is limited. I review the current state of affairs and present original results on three issues: How do plant and arbuscular mycorrhizal (AM) fungal communities co-vary in nature? Are interactions between plants mediated by mycorrhiza? What is the overall effect of mycorrhizal fungi on plant community structure? I conclude that the role of mycorrhiza might be more important than earlier assumed.

Poster A24

Patchy vegetation dynamics of a shrub species influences on vegetation community structure in coastal sand dunes

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Dalbergia ecastaphyllum occurs along coastal sand dunes from Southern Florida (EUA) to Southern Brazil. This species has considerable expansion capacity which suggests a negative association with herbaceous life form in open sand dunes. This relation can be a key process in coastal dunes succession. Dalbergia is frequent on sand dunes and its presence has unknown consequences to long term species persistence that must be investigated. The lack of studies related to negative interactions on environments with extreme conditions as sand dunes, where facilitation is more expected, reinforce the importance of this study. We utilized as study system areas with the shrub species *Dalbergia ecastaphyllum* (L.) Taub. (Fabaceae) (henceforward Dalbergia), in a Brazilian Subtropical region. We investigated how dynamics of expansion and retraction of Dalbergia patches can act on community structure of sand dune plants. In order to analyse allelopathic effects of Dalbergia, we observed influence of aqueous extracts of green and senescent leaves of Dalbergia on germination and growth of *Lactuca sativa* (L.). Additionally, we observed the influence of Dalbergia litter layer on germination and establishment of others species with litter removal experiments in the field. From 2009 to 2012, we investigated the effects of the presence of Dalbergia on other established species (richness and vegetation cover) and effects of Dalbergia expansion on community structure. This investigation was performed by monitoring areas occupied by Dalbergia and adjacent herbaceous areas without Dalbergia. We also evaluated community responses to the removal of Dalbergia with one year of exclusion experiment. Finally, we collected and analysed soils samples under Dalbergia patches and adjacent areas without the shrub. Results indicate the presence of allelopathic effects of senescent and green leaves on L. sativa germination and growth, more intense in the later. This allelopathic effect can reduce richness and diversity in patches of Dalbergia. Litter layer also reduced total germination and survival of other species in the field. Richness and vegetation cover reduction was observed in patches of Dalbergia which made patches apparently monodominants. The presence of Dalbergia was not a modifier factor of soil conditions. Despite the important role of Dalbergia on community structure, this effect does not seem to be prolonged. The removal of Dalbergia of an area allowed slow occupation by others species from adjacent areas. The structure of this community (species richness and vegetation cover) is based on temporal and spatial variations of Dalbergia patches.

Evaluation of productivity in tropical savanna areas under different disturbance histories

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The relationship between diversity and productivity has probably been the most widely documented pattern in terrestrial ecology, and yet is still widely debated. One of the models is the humped-back model, which states that species richness reaches its maximum at intermediate productivity. The aim of this study is to gain further insight into the species richness x productivity discussion by analyzing two tropical savanna (Cerrado) areas with different disturbance histories. This study was carried out in two different areas of tropical savanna communities: one located in Central Brazil at Serra Natural do Tombador (SNT) and the other located in Southeast Brazil at Estação Ecológica de Itirapina (EEI). Both study areas are characterized by a dominant herbaceous layer with scattered shrubs (campo sujo). The area at SNT has been protected from fire for 6 years, while the area at EEI had previously been a Pinus plantation and has been regenerating for nearly 20 years. We analyzed 40 plots (1×1 m) in both areas. We sampled the number of species in each plot and harvested the standing biomass, separating it into live and dead biomass. Litter present in each plot was also harvested. The harvested material was dried at 80oC for 48 hours and then weighed. Average total productivity at SNT ($783,823 \pm 205,43$ g/m^2) is considered medium productivity ($300 - 800$ g/m^2), although almost at its higher limit. Average total productivity at EEI ($844,37 \pm 435,58$ g/m^2) is considered high productivity (> 800 g/m^2), however the high productivity found at EEI is mainly composed of 2 dominant species that are present in nearly every plot (two graminoid species). On the other hand, the intermediate productivity at SNT is composed of a higher number of species (SNT = 14,5 species/m^2 and at EEI = 3,1 species/m^2). Average dead biomass found at both areas is high (SNT = $342,23 \pm 165,71$ g/m^2 and EEI = $329,21 \pm 234,36$ g/m^2) and accounts for 43,66% at SNT and 38,98% at EEI. This is due to the absence of fire, which has led to dead biomass accumulating over the years. We can conclude that a previously disturbed tropical savanna that has been regenerating for nearly 20 years is able to recover its productivity, even with a very low number of species. Our findings were consistent with the humped-back model, where species richness was higher at the site where productivity is considered intermediate.

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